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CURRICULUM

Teacher's Guide
Level 3 — Book 2

SRA
MATHEMATICS
LEARNING SYSTEM TEXT

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Canadian Publication

MATHEMATICS LEARNING SYSTEM

The Canadian publication of *Mathematics Learning System* is completely metric.

On the page given below, the answers in the Teacher's Guide are numerically correct for the questions in the text. However, the questions have been altered to include only metric units. The photograph has also been changed.

Page 107
2. The answers now refer to cents, not yards.

Other changes that have been made in the pupils' text for Canadian use do not affect the teaching of the program.

Teacher's Guide
Level 3 Book 2

SRA MATHEMATICS LEARNING SYSTEM TEXT

M. Vere DeVault
Professor of Curriculum and Instruction
University of Wisconsin

Helen Frehmeyer
Classroom Teacher and
Educational Consultant

Herbert J. Greenberg
Chairman, Department of Mathematics
University of Denver

Stanley J. Bezuszka
Director
Boston College Mathematics Institute

SRA

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4 GEOMETRY SHAPES

before this chapter the learner has—

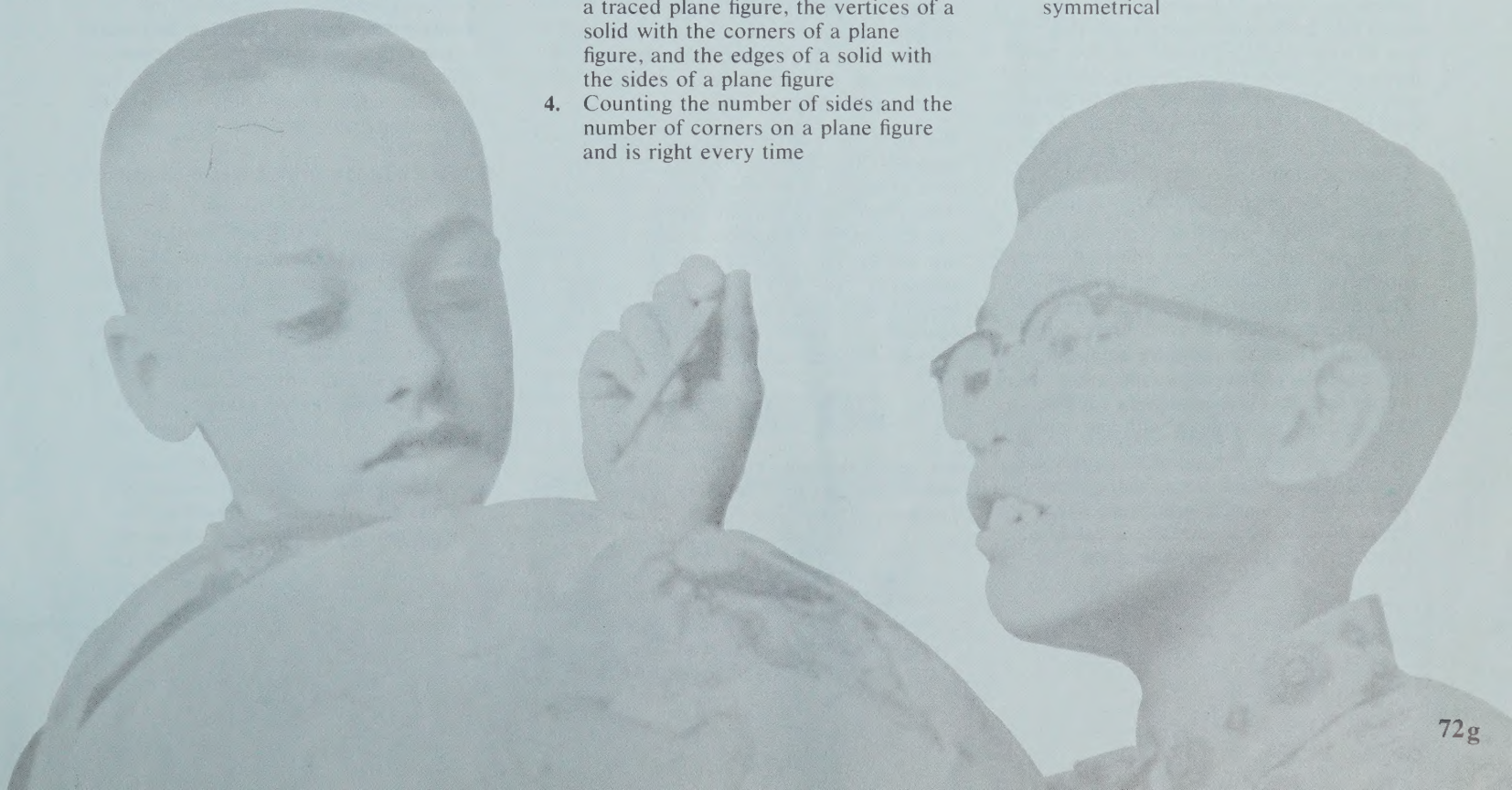
1. Sorted real objects and identified rectangular prisms, cylinders, and spheres
2. Sorted plane figures as triangles, squares, other rectangles, and circles

in chapter 4 the learner is—

1. Correctly identifying flat or curved surfaces
2. Tracing 3-dimensional shapes to form 2-dimensional figures
3. Associating the face of a solid with a traced plane figure, the vertices of a solid with the corners of a plane figure, and the edges of a solid with the sides of a plane figure
4. Counting the number of sides and the number of corners on a plane figure and is right every time

in later chapters the learner will—

1. Examine which shapes fit together best to cover an area
2. Determine whether a figure has a square corner
3. Determine whether a figure is symmetrical



Notes & Things

Geometry can be a joy! The things you need to teach geometry are easy to find. Boxes, balls, and tin cans provide the raw materials to explore geometry in a new way. This chapter makes an assumption that there has already been hands-on experience with the basic geometric solids. It assumes that every child can sort shapes into groups that are like rectangular prisms, spheres, and cylinders. If any of your youngsters have not had these experiences, plan to take two days for the prebook activities described at the end of this Notes and Things section.

The themes of geometry in the first four levels are *shape* and *size*. Understanding of the geometric concepts comes through interacting with objects in the environment. The ideas that come from exploration of our three-dimensional world are mostly intuitive. There is very little emphasis on vocabulary. There are only a few words that should be carefully used so that we can communicate with one another.

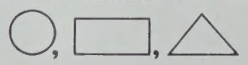
In this chapter the manipulation of solid shapes should yield these "discoveries." The *surfaces* of solid figures are either flat or curved. A flat surface is called a *face*. An *edge* if formed whenever two faces meet and a *vertex* (a sharp point you can feel on three-dimensional objects) is formed whenever three or more edges come together.

As a child looks only at one flat surface of a solid, he will see only a two-dimensional shape called a plane figure. This plane figure has either straight sides or curved sides. If straight sides come together, a corner is formed.

The correct use of the words *face* and *side* is important for the sake of communication. We need the word *face* to talk about a box, for example. A rectangular prism has six faces. The tin can (cylinder) has two faces and one curved surface. The ball (sphere) has no faces at all, but it does have one curved surface.

We need the word *side* to talk about line segments that form just one face. As we look at one face we see a plane figure. That plane figure may be any shape, but this chapter will emphasize faces that are square, rectangular, circular, or triangular. And this brings us to another set of words that should be used precisely by adults. Plane figures or two-dimensional shapes such as

are called regions—circular region, rectangular region, triangular region. Outlines of two-dimensional shapes such as



are plane figures with obvious names of circle, rectangle, and triangle. Picky, picky, picky! Even though we don't expect the child to memorize these labels, it is important that our language be correct and thus serve as a model for their use of words.

All this sounds ominous. Look at the pupil pages to prove to yourself it's not so bad after all. Both you and the children will enjoy this chapter.

things

large box filled with everyday objects (balls, boxes of all sizes, cans, paper cups shaped like cones, plastic pill bottles, cardboard cores from bathroom tissue or waxed paper, mailing tubes, milk cartons, candles, wood scraps that form triangular prisms, any other appropriate junk available for pupils to handle)
commercial geometric shapes if available
graph paper

For extra activities you will want to have an instant camera available.

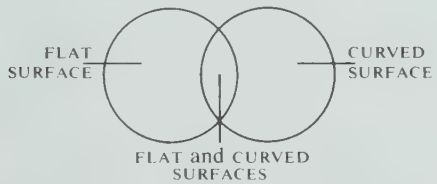
prebook activities 1 or 2 days

goal Providing experience in manipulating and analyzing geometric shapes

things Use the box of shapes described in "Notes and Things" and lots of floor space. Select 3 empty boxes, or 2 hula hoops, or 2 very large sheets of wrapping paper with 2 intersecting circular outlines drawn on it. If you use boxes, each box should have a label:

FLAT SURFACES	FLAT and CURVED SURFACES	CURVED SURFACES

If you use hoops or circles, they must intersect.



first activity Organize manageable groups of children. They are to sort out the shapes into 3 groups:

1. Shapes that sit flat no matter which face is touching the floor (Put them in one box or on the left side of the intersecting circles.)
2. Shapes that roll easily and will not sit flat no matter how you place them on the floor (Put them in another box or on the right side of the intersecting circles.)
3. Shapes that roll easily if you put them on the floor in one position but can sit flat if you put them in another position (Put them in another box appropriately labeled or in the intersection of the two circles.)

You are now able to establish the vocabulary words *flat surfaces* and *curved surfaces*. It is important that each child know that a solid can have both flat and curved surfaces, so emphasize that set of solid objects.

second activity Make a three-column chart on the chalkboard. Allow lots of space. Label the first column FLAT SURFACES. Label the second column FLAT and CURVED SURFACES and label the last column CURVED SURFACES.

Go on a shape hunt in the classroom. Pick up a book. Ask which set the book belongs to. Enter the word *book* in the first column. Show a piece of fruit, or a ball of clay, or a blown-up balloon, or a ball (when all else fails, wad up a sheet of paper), and ask which set this object belongs to. In the third column enter the name of the object you have shown. Then pick a piece of chalk and ask what set that object belongs to. (You may have to make sure it's a new piece, or you won't be able to demonstrate that it can sit flat.) Put the name of this object in the second column.

Divide the class into manageable groups. Have each group select a recorder—someone who will keep track of the objects found on the hunt. Give a different-colored piece of chalk to each recorder so that you'll know who entered what. (Accept pictures of objects as well as words, just in case the recorder isn't worth a hoot in spelling.) Now the groups can begin the hunt. They will classify as many objects in the classroom as they can find in a reasonable amount of time. (If you have a wild group and this hunt could get them off and running, you can make this a completely silent activity by having team members turn in slips of paper to the recorder instead of using oral labels. Oral decision making is by far the best, however, because one child will have an opportunity to learn from another. The decision-making process of several children, as to whether a given object should go into one classification or another, cannot be re-created in ordinary class discussion.)

You can have each group make its own chart if you prefer. Then the recorders should turn their papers in, and other children on the same team should serve as judges to evaluate another team's record as the class discusses the correctness of the classifications.

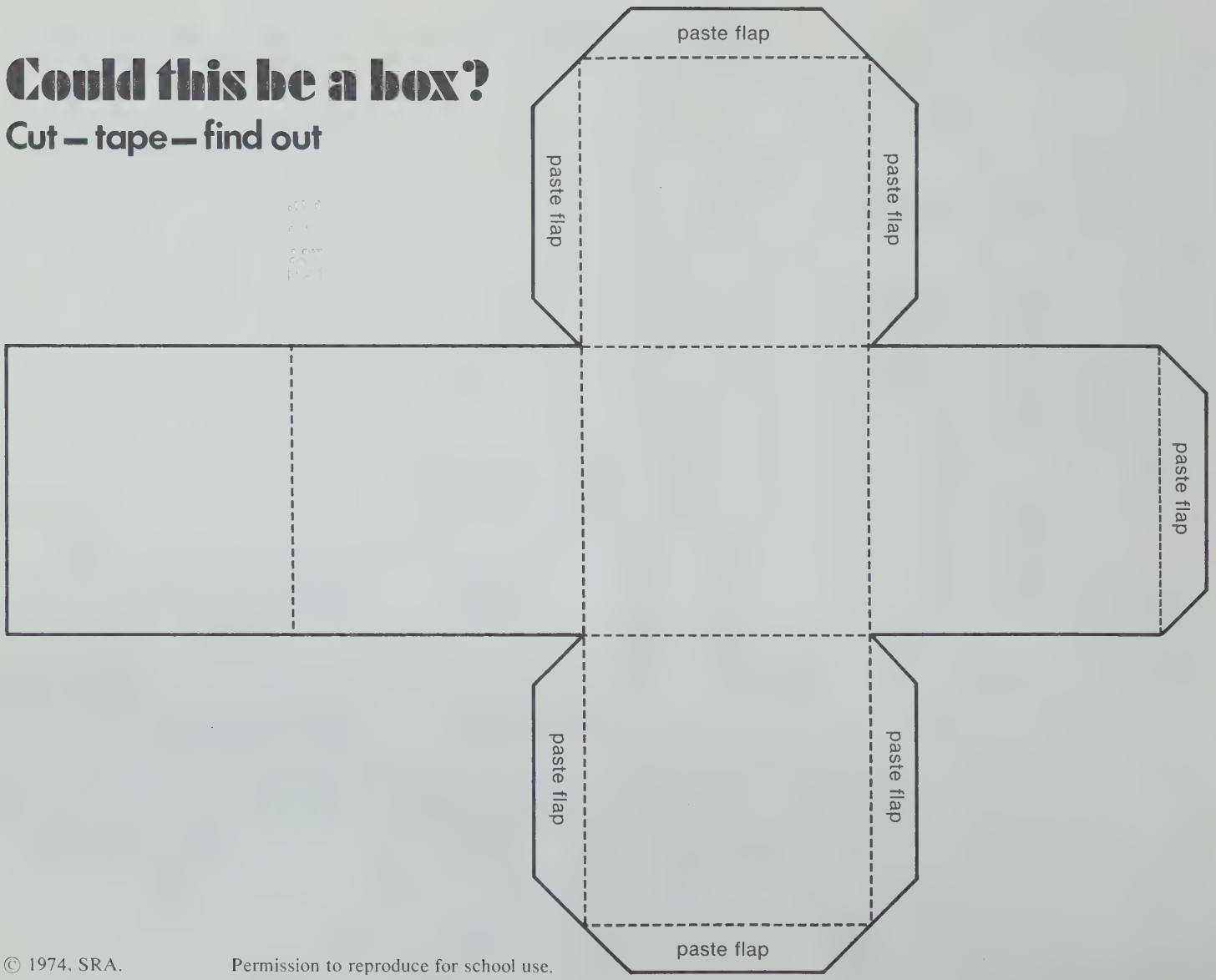
It is hoped that at least one group will observe that a table leg, for example, has both flat and curved surfaces. Discussing parts of a whole is valuable. After all, that table leg was a separate shape at one time.

One point can be given for each correct entry, and a one-point penalty can be assessed for each incorrect entry.

You can continue this activity by asking the pupils to list the names of objects they see on the way home that also fit into these three classifications.

Could this be a box?

Cut – tape – find out



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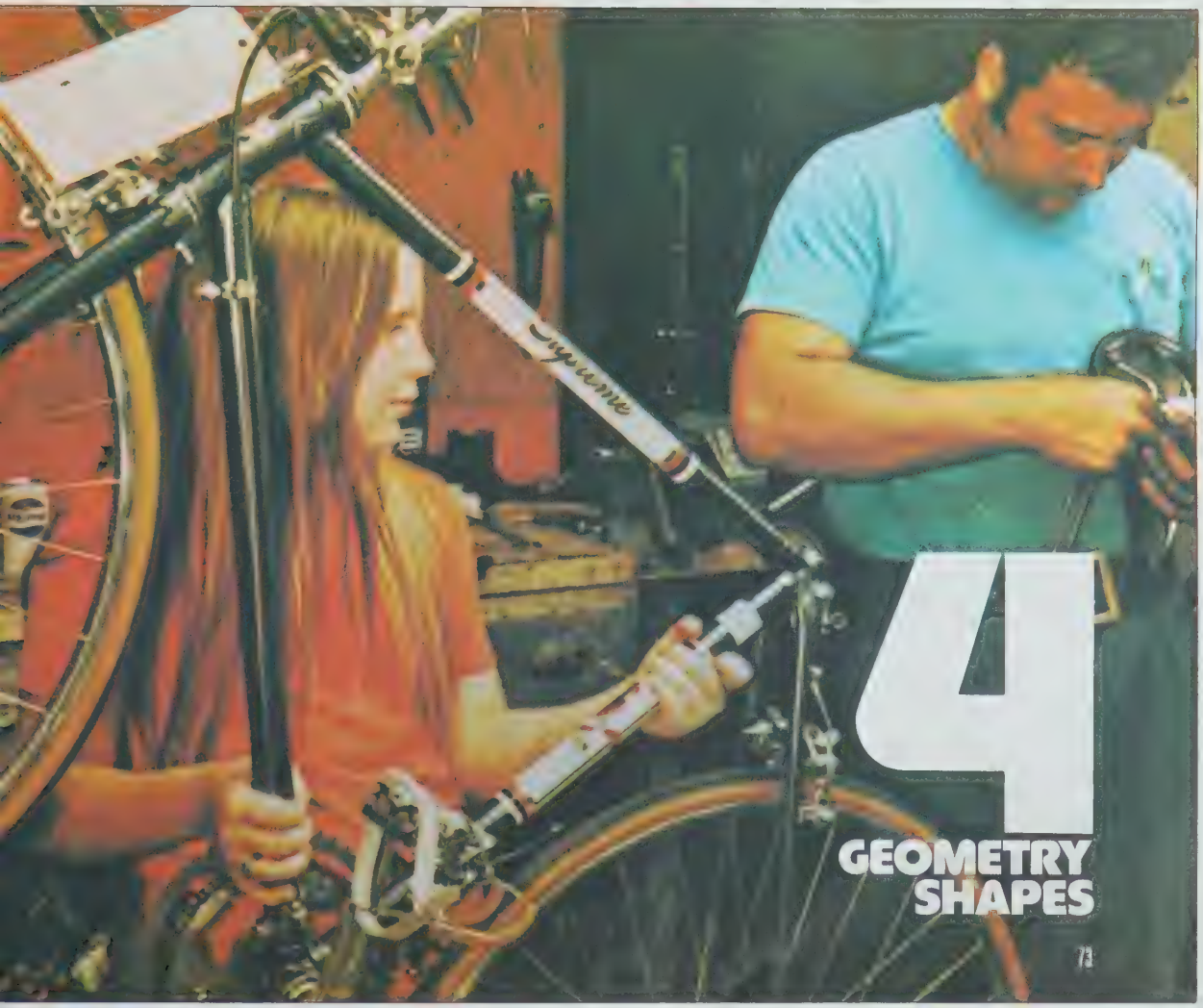


goal Think about and explore ideas through picture clues

page 73 Probably most youngsters look at a bike as a means of transportation and that's all. Looking at all the parts that are needed to make a bike may be a new experience.

Rather than a discussion, have everyone get a sheet of paper and try to make a drawing of the main—separate—pieces needed in order to make a bike. The photograph will give some clues.

Certainly every child will show 2 wheels, but do they also show 2 tires? They will need to show at least 3 long and 2 short cylinder-shaped pieces to have enough raw material for the frame. Is there something that looks like a gear? foot pedals? the cylinder-shaped pieces that fasten the pedals to the gear? What about spokes for the wheels? the handlebars? the seat?

If you could bring a bike into the classroom to verify the drawings, it would be great. If not, make the verification an afterschool assignment.

The purpose of this exercise is to get the youngsters ready for seeing the parts of any whole object. Starting with something they all know about is an effective technique.

lesson Page 74

goal **Survey**—describing surfaces of real-world objects

memo Check your room before the lesson. Make certain that you have a large variety of objects that have the basic shapes of rectangular prism, cylinder, and sphere.

page 74 A time to handle objects and to discuss. Listen for the following words:

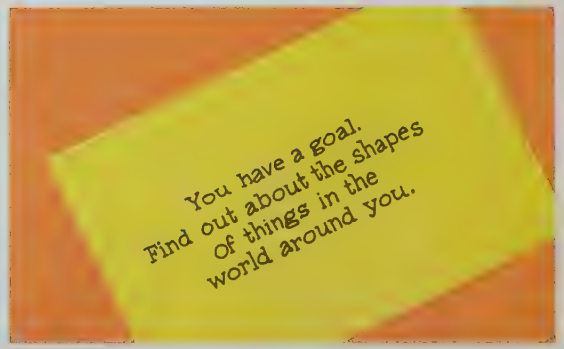
flat	edge
curved	big, bigger
corner	small, smaller
point	straight

Are your pupils aware of shapes and sizes, of curved and flat surfaces of real-world objects?

Let their descriptions and the ease with which they use them determine whether you should take time out to provide the manipulative experiences described in the Resource Section.

Look around the classroom.
Pick three different objects that you can hold in your hands.

Describe what they feel like.
Describe what they look like.
Tell why you think they are shaped the way they are.



74

things instant camera

Are you lucky enough to have access to a camera that develops its own pictures? This is a good time to use it. Have a child handle an object. Then take a picture of this object. The youngster can have the first-hand experience of seeing a 2-dimensional representation of a 3-dimensional object.

You can feel a surface with your hands.

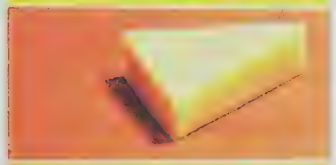
1. How many flat surfaces does this box have? 6
2. How many curved surfaces does it have? 0

You can feel an edge with your finger.

3. How many edges does a box have? 12

4. How many flat surfaces does this orange have? 0
5. How many curved surfaces does it have? 1
6. How many edges does it have? 0

7. How many flat surfaces does this can have? 2
8. How many curved surfaces does it have? 1
9. How many edges does it have? 2



10. How many flat surfaces does this hunk of cheese have? 5
11. How many curved surfaces does it have? 0
12. How many edges does it have? 9

13. How many flat surfaces does this ice-cream cone have? 1
14. How many curved surfaces does it have? 1
15. How many edges does it have? 1
16. A flat surface of a solid object is also called a *face*. What happens when two faces meet? An edge is formed.

lesson Pages 75, 76

goal Identifying flat and curved surfaces and edges

memo It is very hard for some children to look at a picture shown in 2-dimensions and talk about whether the real thing has flat or curved surfaces. Be careful!

things Box of objects found around the home and school or a set of geometric solids

page 75 Talk about the objects pictured. *Who has seen the real thing? Who has seen something shaped like it? Who has really handled the real thing?* Difficulty on this page will signal a potential continuing problem. If someone has trouble, find pictures of objects you know the child has had experience with. Match the picture with the real thing and take time for talk and manipulation with the object. Here is the important question.

How many ways can this object be placed on a table so that it will sit flat and not roll when you give it a little shove?

Hands-on experience is a must or you'll never get the idea of straight or curved surfaces established. Work with real shapes as you discuss the page.

things objects with flat or curved surfaces, paper bag

Place an object in the paper bag. The child feels the object and tells how many flat surfaces, curved surfaces, or whether it has both flat and curved surfaces.

Later, place several objects in the bag. *Do all the things have a curved surface? a flat surface? both kinds of surfaces?* Be careful of the number of objects you use—this is hard for some youngsters. Take the things out of the bag to verify answers.

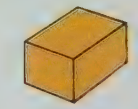
goal Identifying the vertices of an object

things box of objects or geometric solids

page 76 Provide the opportunity for each pupil to **feel** a sharp point. This is an intuitive development of VERTEX. Please save the word **corner** for 2-dimensional shapes.

You can feel a sharp point or a corner with your finger.

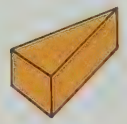
1. How many sharp points does a box have? 8
2. How many sharp points on the box have three edges meeting? 8



3. How many sharp points does a ball have? 0
4. How many sharp points on the ball have three edges meeting? 0

5. How many sharp points does a can have? 0
6. How many sharp points on the can have three edges meeting? 0

7. How many sharp points does a wedge have? 6
8. How many sharp points on the wedge have three edges meeting? 6



9. How many sharp points does a cone have? 1
10. How many points on the cone have three edges meeting? 0

A sharp point on a solid object is called a *vertex*. Whenever three edges meet, there is always a vertex. (The plural of *vertex* is *vertices*—two or more vertices.)

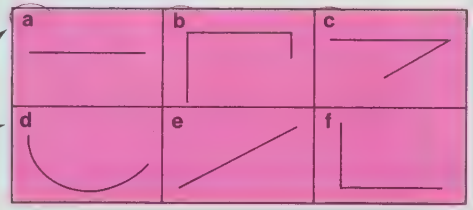
Can there ever be a vertex without three edges meeting? Yes
Think about the cone.

1. Take a box.
   - a Trace *one* of the edges with paper and pencil. Your tracing is called a *line segment*.
   - b Trace another one of the edges. This is another line segment.
   - c Trace two line segments that join at a corner.
   - d Trace one of the faces with pencil and paper.
   - e Does your tracing have any straight parts? Yes
   - f Does it have any curved parts? No

2. Take an unopened can.
   - a Trace a part of an edge with paper and pencil. This is *not* a line segment because it is curved.
   - b Trace one of the faces with pencil and paper.
   - c Does your tracing have any straight parts? No
   - d Does it have any curved parts? Yes

Plane figures are made up of straight parts and curved parts.
Each straight part is called a *side* of the figure.
The point where *straight* sides meet forms a corner.

3. Take your two tracings.
   - a Mark each straight side with a ✓.
   - b Mark each corner with an ✕.
4. Which of these are line segments?



lesson Pages 77, 78

goal Introduction to the concept of plane figures

things small boxes
cans

page 77 Understanding that vertices belong to 3-dimensional objects is easier than getting the child to use the word itself. The notion of a CORNER on a plane figure is developed on this page. The goal is to get the right words used at the right time.

When a pupil traces one edge, he has drawn a line segment. When he goes around the **corner,** he has drawn something other than a line segment. Go easy on the notion of curved lines. The children are far too young to get involved with the math definition that all lines are curves. Stick to the idea that if a line is bent, it is not a line segment—and let it go at that.

When the child traces one edge of a box, then traces the second edge, and then the third and fourth, he has drawn 4 line segments. Once again, don't get involved with the formal math concept that of a rectangle. There's time for that in later levels.

You may want the pupils to do more tracing than is asked for on the page. They need enough experience to **know** that the shape on paper came from the shape in their hand.

STOP

things boxes, cans, containers of various sizes, blindfolds

Blindfold the youngsters. Now have each child handle one of the objects and determine whether the object has straight or curved edges. It may have a combination of both.

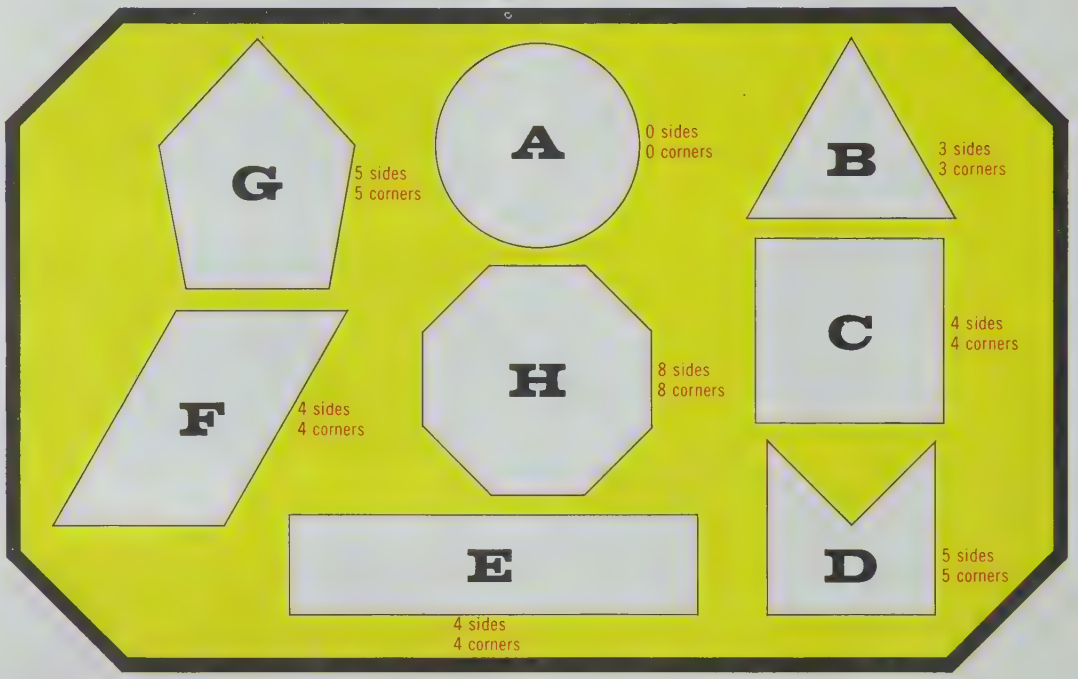
goal Identifying the sides and corners of 2-dimensional figures

memo You may have to review. A plane figure can be thought of as one face of a solid shape. The lines that make up a plane figure are each called a side.

page 78 Have fun with this page. Remember that this is an exploratory chapter. But pupils who have trouble need more tracing experiences, to be followed by their marking the **corners** and **sides** and counting the number of corners and number of sides.

1. How many straight sides does each plane figure have?

2. How many corners does each plane figure have?



3. Look at each figure with all straight sides. Are there the same number of sides as there are corners? Yes

78

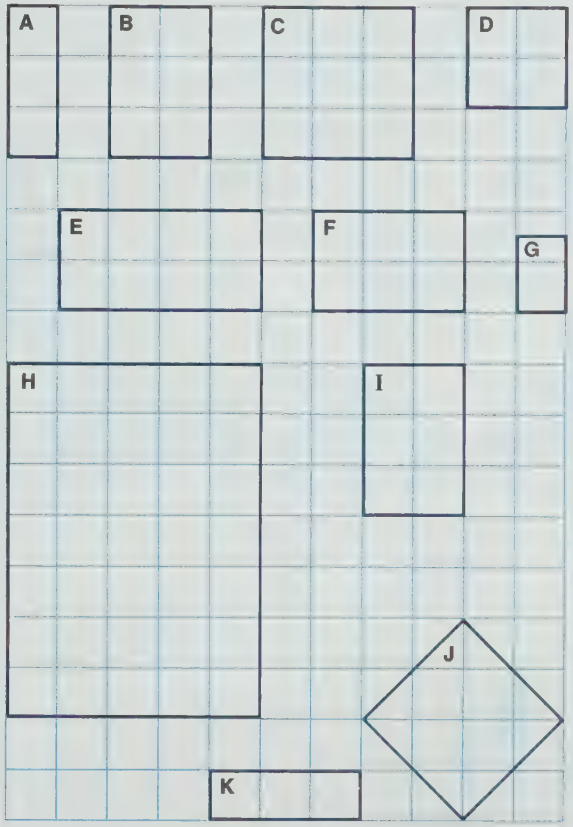
1. Are these plane figures? Yes
2. How many sides does each figure have? 4
3. How many corners does each figure have? 4

These plane figures are called *rectangles*.

4. Look again. Which plane figures have all four sides the same length? C, D, J

A rectangle with all four sides the same length is called a *square*.

5. Name the rectangles that are squares in the picture. C, D, J



lesson Pages 79, 80

goal Examining a square as a special rectangle

things graph paper

page 79 Here is a good talk-together page. It can be a source of genuine discovery. Have the youngsters copy several of the figures on graph paper. Graph paper can be easily duplicated with a spirit master. Challenge them to make some figures the same size, some larger, some smaller.

goal Identifying rectangles, squares, and triangles

things graph paper

page 80 **More talk.**
More activity.
More discovery.
More fun.

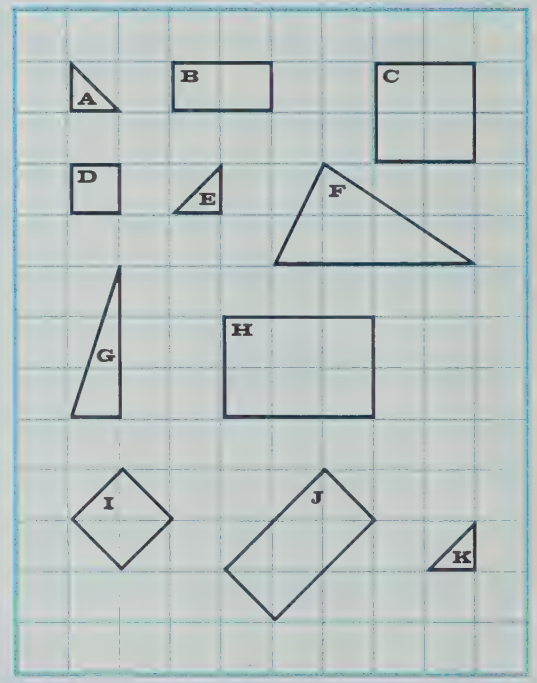
1. Which of these figures are rectangles? B, C, D, H, I, J
2. Are any of the rectangles squares? Yes (C, D, I)
3. Name the plane figures that are not rectangles. A, E, F, G, K
   - **a** How many sides does each of these figures have? 3
   - **b** How many corners does each figure have? 3

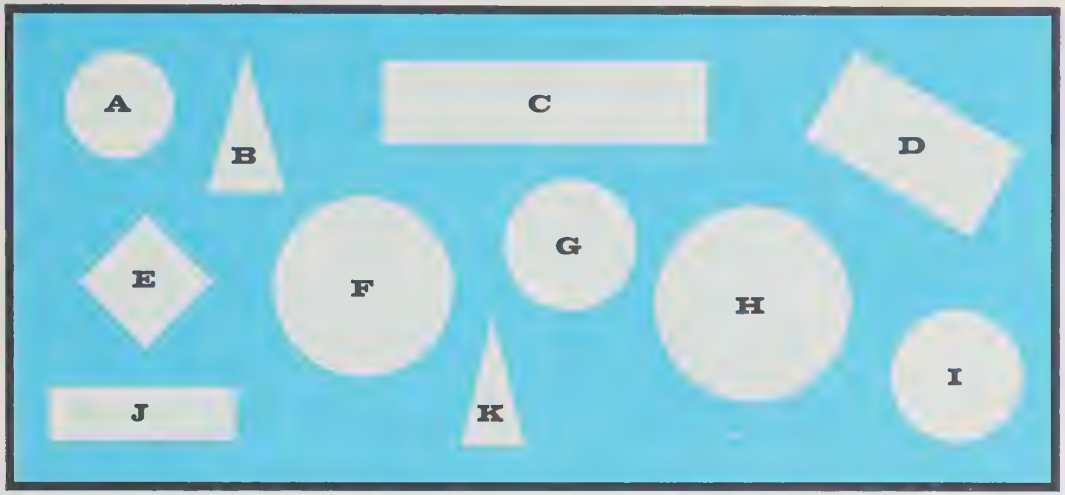
A plane figure with 3 sides and 3 corners is called a *triangle*.

4. Name the triangles in the picture. A, E, F, G, K
5. Do any of the triangles pictured have the same size? Yes (A, E, and K)
6. Draw a rectangle on your paper.
7. Draw a triangle on your paper.
8. How is the rectangle like the triangle? How is it different?

Like: Sides are line segments. Each has the same number of corners as it has sides. Each corner is formed by two sides. Each is a plane figure.

Different: A rectangle has 4 sides and 4 corners; a triangle has 3 sides and 3 corners.





1. Are all these figures plane figures? Yes
2. Which figures have corners? B, C, D, E, J, K
3. Which figures have 4 square corners? C, D, E, J
4. Which figures have 4 sides the same length? E is the only one.
5. Name the triangles. B, K
6. Name the plane figures that are not rectangles or triangles. A, F, G, H, I
   a Do any of them have straight sides? No
   b Do any of them have corners? No

A plane figure that is perfectly round is called a *circle*.

7. Do any of the circles pictured have the same size? Yes (G and I)
8. Is this a circle? No

Is this a circle? No

lesson Pages 81, 82

goal Introduction to the concept of circle

page 81 Use questions 1 through 6 as a check on individual progress. Help with the reading if necessary, but the youngsters should record answers independently.

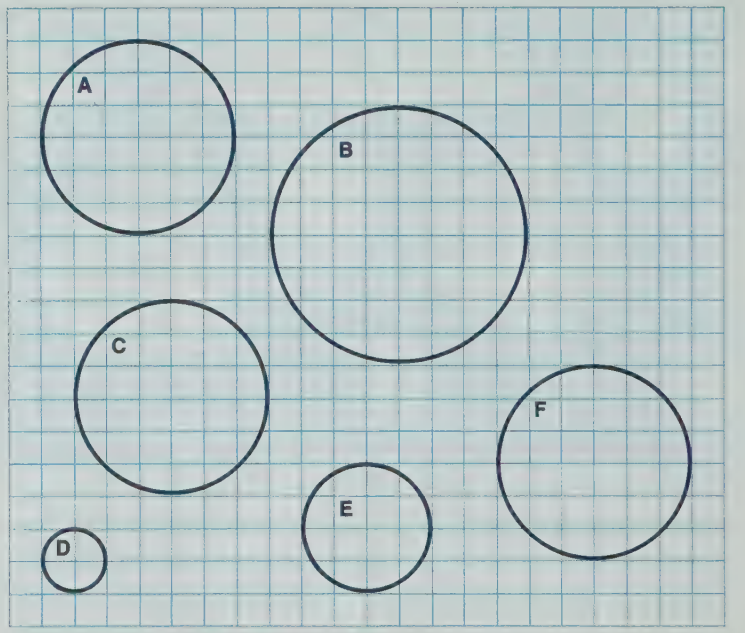
Begin some talk to introduce CIRCLE. How many pupils still want to say that an orange is shaped like a circle? Ugh! The problem of separating the curved surface of a 3-dimensional object and the circular shape of a 2-dimensional object may have to wait until the child is older. Tracing a can and tracing an orange might be fun (and frustrating) at this point.

goal Examining the surface covered by circles of different sizes

memo No, this is not a lesson on area. The idea of the amount of surface covered certainly is close to it, however. Remember—this page is for exploratory ideas, nothing more.

page 82 A discussion page. Check to be sure that the children know what the word **surface** means. Some may count to find the answer for problem 2, so it may take some time. Let them try to answer independently. Then discuss as a group. Explore the possibilities for problem 6. You may get some interesting ideas. Extend the lesson. Turn back to pages 79 and 80. You can talk about the surface covered by the figures on those pages, too.

1. Are all the figures on this page the same shape? Yes



2. Which circle covers the most surface? B

3. What happens when you try to count the number of squares each circle covers?
You get parts of squares as well as whole squares.

4. Can you find out *about* how many squares are covered? Yes

5. Name the circles that look the same size.
A, C, F

6. There are at least two ways that you could make sure two circles are the same size. Can you figure out at least one way? Accept any reasonable answer.
Examples: Measure or count the squares across the middle of the circle. Measure around the circle. Trace the circle.

Talk about these. Discuss. Examples are shown.

1. WHY are most windows shaped like a rectangle?
Easy to make—it's hard to get a curved shape in a metal or wood frame; standard manufactured size; easy to open and store

2. WHY are doors shaped like rectangles?
Standard manufactured size

3. WHY are some tables round? Everyone is same distance from center; more people can be seated; convenience.

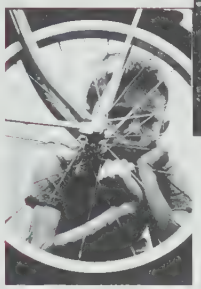
4. WHY is a book shaped like a rectangle? Easier to manufacture and paper is not wasted; easier to package for mailing

5. WHY is a wheel shaped like a circle?
So it will roll smoothly

6. WHY is the brim of a hard hat curved? Fit Why isn't it the shape of a circle? People's heads are not really circular.

7. WHY do most boxes have flat surfaces?
Better storage; carrying; shipping

8. WHY can a sandwich be cut to form two triangular shapes as well as two rectangular shapes?
Can cut diagonally or across the middle because of the rectangular shape of the bread itself



CHECKOUT

What shapes can you find in your room?
Answers will vary. Examples: windows, doors, desks may be rectangular; lights may be circular.

See activities 1 and 2, page 83a.

lesson Page 83

goal Examining real-world uses of geometric figures; **Checkout**—identifying shapes in the real world

page 83 Have fun! Turn those imaginations loose. This is a wide-open discussion page. There are no questions that have only one answer.

You may want to handle the Checkout as part of the discussion or in written form. If spelling is a problem, let the youngsters draw pictures for their answers.

RESOURCES

another form of evaluation

for Checkout—page 83
What shapes can you find in your favorite toy? What shapes might you see if you rode in a car on a busy expressway? Answers will vary. Example: road signs that are rectangular

activities

1. Have the youngsters collect postcards and pictures that show how we have used flat and curved surfaces in construction. The side of a building might be triangular, circular, rectangular, or square. A dome-shaped building has a curved surface. Look for straight and curved edges—all the ideas that have been explored in this chapter.

The pictures can be displayed on the bulletin board and serve as the basis for discussion—or for original experience stories in a language lesson.

2. things spirit master (see next page), scissors, paste, variety of colored paper, sheets of background paper.

Prepare a spirit master including triangles, squares, rectangles, and circles. Run the spirit master on a variety of colored paper.

A cut-and-paste project for everyone! Have the youngsters cut out the shapes, arrange a design, and paste it on a sheet of background paper. This is an especially rewarding experience for the children and makes a good art project too.

additional learning aids

concept—chapter objectives 1, 2, 3, 4

SRA products

Mathematics Involvement Program, SRA (1971)
Cards: 222, 232, 302, 193, 203, 44
Skill through Patterns, level 3, SRA (1974)
Spirit masters: 1, 2, 10, 21, 22, 59, 61, 63, 64, 65

other learning aids (described on page 144i)—Geoboard Activity Cards (primary set), Geoboard Kit, Metric Primary Shapes, Paper and Pencil Geometry, Pattern Blocks and Mirrors

Notes & Things

Many pupils will reach the year-end mastery objective for subtraction with the experiences in this chapter. The concept of subtraction has been explored by manipulating counters in ten-trays. The take-away approach has consistently been used to introduce the number facts, subtraction of multiples of 10, and even renaming.

This chapter returns to the idea of renaming. The ten-tray model will be replaced with cartons and cans of pop, so there is something new to look at. But the idea itself is not new. The first pages of this chapter review the material in chapter 1. Cross your fingers—no one will have forgotten everything. If you have reason to think that some children need still more manipulative experiences, please dig out the ten-trays and use them again. It is the best way to start over.

The subtraction algorithm does not change from the one in the first chapter either. It simply expands to include hundreds. The renaming skill will be the only potential troublemaker. Please consider the reason for the slight change in emphasis on renaming. The analysis of errors on tests given early in the year to fourth-level pupils across the nation revealed some surprisingly consistent error patterns. Other than simply not knowing the subtraction facts, subtraction errors fell into the two major categories exemplified below.

$$\begin{array}{r} 16\,3 \\ -\ \ 5\,8 \\ \hline 11\,5 \end{array}$$

No renaming at all. The two numbers were reversed. (We wondered if there had been too much emphasis on the commutative property of addition, but there was no way of finding out.)

$$\begin{array}{r} 1\,6\,{}^{1}3 \\ -\ \ 5\,8 \\ \hline 1\,1\,5 \end{array}$$

The renaming was only partly completed. The tens were not renamed.

Since these were fourth-level pupils, it meant that third-level materials had to carry the burden of preventing these errors from happening. Therefore, these materials recommend that all renaming be done as the first step in the subtraction operation. If you disagree with this approach, the pupil pages are such that you can use your own favorite technique. We all share the common goal of getting computational proficiency. There are many ways to reach that goal, and you should use the one that you have found most successful.

things

spirit master of 10-by-10 array of squares
play money
bundles of 10 sticks or 10-strips, single sticks
for each pupil: 10 paper 2-cm or 1-inch squares
for each group: 93 counting sticks, rubber bands

For the extra activities, you will want to have these things available:
9″ fluted-edge paper plate
6″ paper plate
paper fastener

goal Think about and explore ideas through a picture clue

page 84 This simple photograph is a classic model for subtraction. You may want to talk about what might be inside the bottles or how large the bottles are. (The hand will provide the clue to the size.) But the thrust of the discussion will be directed toward the action in the photograph and the words that could be used to describe it.

If you had only this photograph to look at, could you answer these questions?
- *How many bottles do you see in all?*
- *How many are being* ***taken away?***
- *How many* ***are left?***

Could you answer this question also? How many bottles ***remain*** *after two are* ***taken away?***

Listen to these words:
- *I am* ***removing*** *2 of the 5 bottles. How many are on the shelf now?*
- *There were 5.* ***I took*** *2. How many* ***are left?***
- *There are 5. 2 will be used.* ***How many more*** *can be used?*

We have used a lot of different words to describe the action in this picture. They all give us a hint that we are supposed to use subtraction to find the answers. Are there other words that could be used in a problem to give us the clue that we would subtract.

It's O.K. if you don't get any new ideas. List those that you have, and display the list somewhere in the room. Add to the list as pages with word problems are completed.

Here is an incomplete story. You finish it. Find good words for the ▭ and the right numbers to put in place of the ≋ Any word can be chosen.

Mom said I was getting selfish.
She said I had to learn to share.
I looked at all the things I had
And was surprised at what was there.

For example:
I had 8 ▭ fish
I gave 2 ▭ to my sister Sue.
I now had ≋ ▭ remaining, 6 fish
So I really wasn't blue.

I wanted 22 ▭
I kept 12 ▭ behind my closet door.
I gave ≋ ▭ away. 10
Then I wished that I had more.

There were 25 ▭
I had to give 9 to my cousin Jill.
There were only ≋ left 16
To share with my cousin Bill.

Sue was so pleased, she gave me 5 ▭
And Jay gave me 6 ▭ too.
Cousin Bill and cousin Jill shared 10 ▭
Now what am I to do?

Your story may not have made sense, but you did some arithmetic that should have made sense. That arithmetic is part of the goal you will want to reach in this chapter.

YOUR GOAL

is to gain skill in subtracting.

lesson Page 85

goal **Survey**—skill in using subtraction

page 85 The ease with which each child answers the questions will indicate to you the pace at which the chapter can be used.

Read the story together so that everyone will get a feel for the rhyme. Encourage imaginative substitutes for the boxes. Ask the pupils to draw a picture of what each chose to fill in the box. Ask them to record the number. Caution them that the numbers that replace the wavy lines have to make sense. Does changing the choice for the box also change the numbers? Have fun sharing their completed stories.

The learning goal of the chapter is simple for adults to understand, but the word **skill** may be too fancy for the children. Take time to talk about the word. *Do you know how to type? Do you know someone who can do it well? That person has a typing skill.* You also might talk about the skills of cooking, driving, skating, and so on.

lesson Pages 86, 87

goal Identification of skill with the easy subtraction facts

page 86 *What is a superstar? Can you name some superstars? Can everyone on a team be a superstar? Is it likely to happen?* Pupils should understand that there are three categories of players in sports: the regular players, who must be good just to make the team; the stars, who are the outstanding players on a given team; and the superstars, who are the best among all the teams. With this concept of superstar, the pupils who do not make the rank on the first round shouldn't be too upset. The material is designed so that nearly all should make superstar rank by the end of the chapter.

This chapter can be an excellent opportunity for you to provide some healthy competition. But please don't let a slower pupil be overwhelmed by the competition.

Discuss the point system. You may want to put up a chart in the room to record Superstar points.

The type of illustration shown in the example is used frequently, so the pupils must understand that the open cans represent the number to be subtracted.

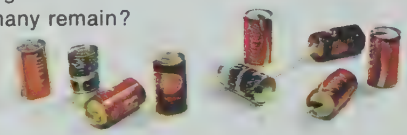
Pupils should complete rows 1 and 2 independently, and the points should be recorded on the Superstar chart. A pupil who misses more than one fact needs help. Everything done in this chapter builds on the subtraction facts.

You will want to know your progress. Keep score. Some sets of problems will have this symbol.

It is a Superstar. It signals you to keep a record of the number of problems you get correct. You'll also want to keep track of your total score for all sets of Superstar problems. Your goal is to earn 100 points.

Here is the first Superstar set of problems. Put your paper under the first row. Then write your answers on your paper. Fold your answers under. Then you will be ready for the second row.

There are 9 cans of soda pop in the refrigerator. You and your friends drink 5 of them. How many remain?



$$\begin{array}{r} 9 \\ -\ 5 \\ \hline ?\ \ 4 \end{array}$$

	a	b	c	d	e	f	g
1.	9 − 4 = 5	9 − 7 = 2	9 − 3 = 6	9 − 0 = 9	9 − 8 = 1	9 − 6 = 3	9 − 2 = 7
2.	7 − 1 = 6	3 − 1 = 2	8 − 6 = 2	5 − 4 = 1	7 − 3 = 4	6 − 4 = 2	5 − 3 = 2

How many points?

Answer depends on individual score.
Possible points: 14

86

See activity 1, page 108a.

See activity 2, page 108a.

1. Imagine soda pop coming 10 cans in a carton. A grocery store has 50 cans. Your father buys 20 of them. How many remain at the store?

	tens	ones
5 tens	5	0
− 2 tens	− 2	0
3 tens →	3	0

	a	b	c	d
	tens ones	tens ones	tens ones	tens ones
1.	6 0	9 0	5 0	4 0
	− 5 0	− 6 0	− 3 0	− 3 0
	1 0	3 0	2 0	1 0
	tens ones	tens ones	tens ones	tens ones
2.	7 0	6 0	8 0	9 0
	− 4 0	− 6 0	− 1 0	− 5 0
	3 0	0	7 0	4 0

That was your practice.
Now earn some more points.

	tens ones	tens ones	tens ones	tens ones
3.	6 0	9 0	7 0	7 0
	− 4 0	− 7 0	− 5 0	− 6 0
	2 0	2 0	2 0	1 0
	tens ones	tens ones	tens ones	tens ones
4.	5 0	8 0	6 0	9 0
	− 4 0	− 3 0	− 2 0	− 3 0
	1 0	5 0	4 0	6 0

Possible points: 8

goal Review of subtracting multiples of 10

things for each pupil:
10 paper squares (2 cm or 1 inch is a good size)

warm-up Pupils should prepare ten squares of paper for themselves. The number 10 should be written on each square. Pretend that each square is a box of pop with 10 cans inside. Count by tens. *How many cans in all?*

page 87 The first set of problems should be completed with the squares. The answers may be obvious to some youngsters, but they should be required to manipulate the squares regardless. We want to remind them that numbers are for real and not just mystical symbols that dance on paper.

After the first set of problems has been completed, go through them again to confirm the answers. This time pretend the squares are dimes. *How much money is left?*

The rest of the page is independent work. Again record the points on the Superstar chart, after the papers have been corrected.

lesson Pages 88, 89

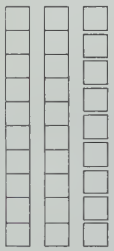
goal Identification of skill with the **harder** subtraction facts; review of subtraction, no renaming

things 10-by-10 array of 1″ squares

page 88 Complete the Superstar set in class. Have pupils compute their cumulative score. If a pupil misses more than one fact, he needs more practice. Put the old-fashioned flash cards to work again. Consider enlisting the help of mom or dad. Parents want to know their child's progress; and at this point in time, is is realistic to ask that all subtraction facts be mastered.

Discuss the example for exercise 4. Pupils who have trouble understanding might profit from using manipulatives. Cut a 10-by-10 array of squares into strips of 10 and single units. These can be duplicated on a spirit master so that each pupil can have his own set. These will be particularly helpful later when renaming is the focus.

$$\begin{array}{r} 29 \\ -\ 8 \\ \hline \end{array}$$



Remove 8.
How many are left?

Pupils work exercise 4 independently. Notice that **no** renaming is involved.

How many remain?

$$\begin{array}{r} 11 \\ -\ 5 \\ \hline ?\ \ 6 \end{array}$$

	a	b	c	d	e	f	g
1.	11 − 6 = 5	11 − 3 = 8	11 − 2 = 9	11 − 9 = 2	11 − 7 = 4	11 − 8 = 3	11 − 4 = 7
2.	13 − 9 = 4	12 − 8 = 4	14 − 5 = 9	15 − 6 = 9	10 − 6 = 4	18 − 9 = 9	17 − 8 = 9
3.	14 − 8 = 6	16 − 7 = 9	15 − 9 = 6	16 − 8 = 8	17 − 9 = 8	15 − 8 = 7	16 − 9 = 7

Total score now?

Look at $\begin{array}{r} 29 \\ -\ 8 \\ \hline ? \end{array}$ Are there any tens in 29?

tens	ones
2	9
−	8
■	■

Answer depends on individual score.
Possible points: 21
Possible total score: 43

Try these. Subtract.

	a	b	c	d	e	f	g
	tens ones	tens ones	tens ones	tens ones	tens ones	tens ones	tens ones
4.	2 8 − 4 = 2 4	3 9 − 7 = 3 2	5 7 − 3 = 5 4	9 9 − 5 = 9 4	6 5 − 4 = 6 1	5 5 − 5 = 5 0	3 7 − 6 = 3 1

88

STOP

See activity 3, page 108a.

1. Would you be satisfied if—

a You bought a bag of candy for 31 cents, you gave the clerk 51 cents, and you got back 10 cents change? No

b You bought a model car for 69 cents, you gave the clerk 75 cents, and you got back 6 cents change? Yes

c You bought a book for 49 cents, you gave the clerk 55 cents, and you got back 5 cents change? No

d You bought a hamburger for 55 cents, you gave the cashier 75 cents, and you got back 15 cents in change? No

e You bought a can of pop for 10 cents, you put a quarter in the machine, and you got back a dime in change? No

Problems 2–5: Answers may vary. Examples are shown.

2. What coins could you have in your pocket if you had 35 cents?
1 quarter and 2 nickels, 7 nickels, 3 dimes and 1 nickel, 35 pennies

3. What coins could you have in your bank if you had 75 cents? 3 quarters, 1 half-dollar and 5 nickels, 7 dimes and 5 pennies, 75 pennies

4. What coins could you use to pay for a ticket that cost 50 cents? 1 half-dollar, 2 quarters, 4 dimes and 2 nickels, 10 nickels, 5 dimes, 50 pennies

5. What coins could you get if you got paid 25 cents for an errand? 5 nickels, 1 quarter, 2 dimes and 1 nickel, 25 pennies

6. Could you have only three coins and have—

a 16 cents? Yes
1 dime, 1 nickel, and 1 penny

b 31 cents? Yes
1 quarter, 1 nickel, and 1 penny

c 56 cents? Yes
1 half-dollar, 1 nickel, and 1 penny

d 45 cents? Yes
1 quarter and 2 dimes

goal Application of subtraction with 2-digit numbers, no renaming

things play money

page 89 Problem 1 can be fun. Consider having the youngsters act out each part of the problem. Use different combinations of coins for making change (for 55¢, use 1 fifty-cent piece and 1 nickel, 2 quarters and 1 nickel, and so on). Encourage the pupils to use the coins to help them count **from the number** rather than do actual computation. This will always be the most effective way of making or counting change.

Problems 2 through 6 are independent work. Expect a wild variety of answers. If no variety is evident, use the idea to extend the page activities. Keep challenging. *Is there another set of coins that could have been used for change?*

lesson Pages 90, 91, 92

goal Review of subtraction with no renaming; renaming 3-digit multiples of 10 as tens

page 90 Make sure that the model is understood. *How does the picture tell you how many were used?* Emphasize subtracting ones first. Rows 1 and 2 should be completed independently.

The renaming that starts with problem 3 is important. If there is any confusion, take out those 10-strips (page 88) again. *Count by 10s. How many in all? Count the tens. How many tens?*

The cartons were full.
There were 4 extra cans. 54 in all.
3 cartons and 1 can were used.
How many remain?

tens	ones
5	4
− 3	1
?	?
2	3

	a	b	c	d
	tens | ones	tens | ones	tens | ones	tens | ones
1.	6 | 8	4 | 4	7 | 2	9 | 7
	− 2 | 7	− 3 | 2	− 5 | 2	− 6 | 3
	4 | 1	1 | 2	2 | 0	3 | 4
2.	3 | 8	6 | 6	8 | 4	5 | 7
	− 2 | 4	− 5 | 1	− 2 | 3	− 3 | 4
	1 | 4	1 | 5	6 | 1	2 | 3

3. How many cartons? 11
   - a How many cans in all the cartons? 110
   - b Can we rename 110 as 11 tens? Yes
   - c Can we rename 160 as 16 tens? Yes

4. Rename as tens.
   - a 150 — 15 tens
   - b 120 — 12 tens
   - c 220 — 22 tens
   - d 170 — 17 tens
   - e 190 — 19 tens
   - f 340 — 34 tens

How many remain?

hundreds	tens	ones	
1	1	0	How many tens in 110?
−	3	0	How many tens in 30?
?	?	?	How many ones in the answer?
			How many tens in the answer?

11	0
− 3	0
■	■
8	0

	a	b	c	d
	tens ones	tens ones	tens ones	tens ones
1.	14 0	17 0	13 0	15 0
	− 9 0	− 8 0	− 7 0	− 7 0
	5 0	9 0	6 0	8 0

How many remain?

tens	ones
12	5
− 5	3
■	■
7	2

	a	b	c	d	e	f	g
	tens ones	tens ones	tens ones	tens ones	tens ones	tens ones	tens ones
2.	13 6	12 9	15 4	11 8	10 7	14 7	16 9
	− 8 5	− 4 4	− 8 3	− 3 8	− 7 5	− 7 6	− 9 6
	5 1	8 5	7 1	8 0	3 2	7 1	7 3

goal Review of subtracting a 2-digit number from a 3-digit number, no renaming to ones

memo Look carefully at the model for problem 1 before you introduce it to your pupils. This may be a surprisingly different approach. Thinking about 110, for example, as 11 tens will make it possible to maintain emphasis on the subtraction facts. Please give this approach a try. Youngsters should have no difficulty accepting the model. Their **new** learning is minimized, but their gains in computational proficiency should be maximized.

page 91 Hundreds being renamed as tens is the foundation for all subsequent work in the chapter. Let the pupils count the boxes of 10 in the model to reinforce the concept that 11 tens is 110. You may find it necessary to use a few more examples. Consider using 10-strips as a counting aid. Check this development by having them complete row 1 independently. There must be success here! If not, provide more manipulative practice before going on.

There is another model to understand. Pupils who fully understand the work in row 1 should have no trouble. Check for carelessness with facts.

goal Identification of skill in subtracting a 2-digit number from a 3-digit number, no renaming to ones

page 92 The page should be completed during class time. As you correct the papers, watch for the types of errors pupils make. Those who miss more than one problem need individual help.

Are subtraction facts the cause of difficulty? Assign peer tutors and drill with flash cards. You will also want to use any drill kits you have available. And remember—there are ideas in chapter 1 as well as at the end of this chapter.

How many Superstar points do you have so far?

Can you work these problems without any mistakes?
Make more points. Use the folded-paper idea for your answers.

1. 70 − 50 = 20	**2.** 60 − 40 = 20	**3.** 90 − 30 = 60	**4.** 130 − 50 = 80	**5.** 140 − 60 = 80
6. 120 − 90 = 30	**7.** 93 − 32 = 61	**8.** 75 − 51 = 24	**9.** 89 − 76 = 13	**10.** 117 − 44 = 73
11. 136 − 95 = 41	**12.** 145 − 60 = 85	**13.** 158 − 83 = 75	**14.** 142 − 52 = 90	**15.** 165 − 74 = 91

Total score so far?

Answer depends on individual score.
Possible points: 15
Total possible score: 58

If you got one wrong, can you find your mistake? Have you made that mistake before? If you got more than two wrong, what do you need to do?
Get help and practice more

92

See activity 4, page 108a.

Suppose the store now has 42 cans of soda pop in all.
There are 4 cartons and 2 extra cans on the shelf.
You and your friends buy 7 cans.
How many are left?

How many tens? 4
How many ones? 2
Can you take away 7 when you have only 2? No

4 tens	2
−	7
	NO!

The clerk had to empty a carton to get enough.

3 tens	12
~~4 tens~~	~~2~~
−	7
? tens	?

Now how many tens? 3
How many ones? 12
Can you subtract 7 now? Yes
How many ones? How many tens? 3 5

tens	ones
3	12
~~4~~	~~2~~
−	7
3	5

You will need to copy these problems. Then work them.

1.

tens	ones
2	15
~~3~~	~~5~~
−	7
2	8

2.

tens	ones
5	13
~~6~~	~~3~~
−	6
5	7

3.

tens	ones
4	11
~~5~~	~~1~~
−	4
4	7

4.

tens	ones
7	14
~~8~~	~~4~~
−	5
7	9

5.

tens	ones
6	17
~~7~~	~~7~~
−	9
6	8

6.

tens	ones
5	12
~~6~~	~~2~~
−	8
5	4

7.

tens	ones
8	13
~~9~~	~~3~~
−	9
8	4

Can you write plus and minus signs between the ten numbers on the left side of this sentence to make it true?
1 2 3 4 5 6 7 8 9 10 = 1

Make up your own puzzle. Challenge a friend.

Answer:
1 + 2 − 3 + 4 + 5 − 6 + 7 − 8 + 9 − 10 = 1

lesson Pages 93, 94

goal Review of subtracting a 1-digit number from a 2-digit number with renaming

things for each group:
93 counting sticks
rubber bands

warm-up Group the youngsters. Have each group count sets of 10 and put a rubber band around each set. Have them show 56. *Take away 8. Does anyone have an idea of how we can solve our problem?* (Change a ten to ones.) *How many tens now? How many ones? How many remain?*

page 93 The model shows breaking into a new carton to get enough ones, but the pupils can show the action with their counting sticks. But remember—recording the action is the most important thing to do.

Encourage the youngsters to rename the ones and tens before the subtraction is started. It will prevent this common error:

tens	ones
4	~~2~~ 12
−	7
4	5

The ten used is forgotten.

Those who are working confidently can complete the page without manipulatives. Anyone who makes a mistake should rework the problem with manipulatives.

goal Identification of ability to subtract a 1-digit number from a 2-digit number with renaming

page 94 The model is for review. Have the pupils do the Superstar problems independently.

Problem 3 should also be completed independently. Finding someone else's mistakes is so much more fun than finding one's own. Encourage the use of bundles of sticks by anyone who has trouble.

Here is another way to think about cans of soda pop.

tens	ones
5	3
–	9
	NO!

5

← How many tens? How many ones? 3

tens	ones
4	13
~~5~~	~~3~~
–	9
■	■
4	4

4

← Now how many tens? How many ones? 13

Now subtract.

How many ones? How many tens? 4 4

Are you ready for a Superstar set of problems? Subtract.

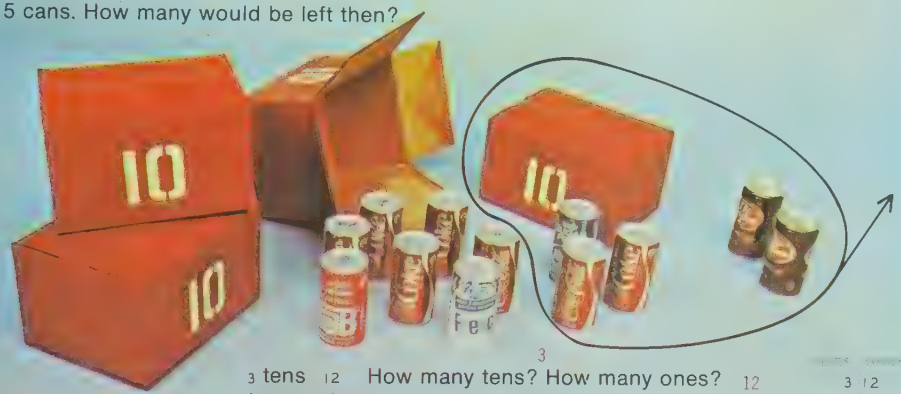
	a	b	c	d
	tens | ones	tens | ones	tens | ones	tens | ones
1.	4 | 13 ~~5~~ | ~~3~~ – | 6 4 | 7	2 | 11 ~~3~~ | ~~1~~ – | 5 2 | 6	5 | 15 ~~6~~ | ~~5~~ – | 7 5 | 8	3 | 14 ~~4~~ | ~~4~~ – | 9 3 | 5
2.	8 | 11 ~~9~~ | ~~1~~ – | 3 8 | 8	6 | 12 ~~7~~ | ~~2~~ – | 8 6 | 4	2 | 15 ~~3~~ | ~~5~~ – | 6 2 | 9	4 | 10 ~~5~~ | ~~0~~ – | 3 4 | 7

Total score so far? Answer depends on individual score.
Possible points: 8
Possible total score: 66

Find the mistakes. What are the right answers?

	a	b	c	d
3.	5 | 4 – | 9 ~~5~~ | ~~5~~ 4 | 5	4 | 2 – | 5 ~~3~~ | ~~3~~ 3 | 7	6 | 0 – | 8 ~~5~~ | ~~6~~ 5 | 2	3 | 6 – | 7 2 | 9 Right

Remember those 4 cartons and 2 extra cans of soda pop on the shelf? Suppose you and your friends bought 15 cans. How many would be left then?



3 tens 12	How many tens? How many ones?	12
~~4 tens 2~~		
− 1 ten 5	Subtract.	
? tens ?	Now how many ones? How many tens?	
	2	7

3

3	12
~~4~~	~~2~~
− 1	5
■	■
2	7

Your turn. Copy and complete.

	a	b	c	d	e	f
	tens ones	tens ones	tens ones	tens ones	tens ones	tens ones
1.	4 13 ~~5~~ ~~3~~ − 2 6 2 7	5 11 ~~6~~ ~~1~~ − 1 8 4 3	6 14 ~~7~~ ~~4~~ − 5 7 1 7	2 12 ~~3~~ ~~2~~ − 1 5 1 7	4 17 ~~5~~ ~~7~~ − 2 9 2 8	7 16 ~~8~~ ~~6~~ − 5 8 2 8
2.	3 10 ~~4~~ ~~0~~ − 2 1 1 9	8 15 ~~9~~ ~~5~~ − 3 6 5 9	6 12 ~~7~~ ~~2~~ − 4 5 2 7	2 16 ~~3~~ ~~6~~ − 1 7 1 9	5 11 ~~6~~ ~~1~~ − 2 7 3 4	8 10 ~~9~~ ~~0~~ − 3 3 5 7

lesson Pages 95, 96, 97

goal Review of subtracting two 2-digit numbers with renaming

memo It is possible that the pupils will not even notice that this page shows subtraction of a 2-digit number rather than of a 1-digit number. That would be great! It is still important to ask how many ones and how many tens.

things bundles of 10 sticks or 10-strips
single sticks

page 95 The action shown in the model can also be shown with manipulatives if necessary. The emphasis on the subtraction facts within a place-value framework should allow each pupil who has mastered the computation up to this point to complete this work with confidence. Continue the use of manipulatives with anyone who still requires this aid.

goal Application of subtraction; identification of skill in subtracting two 2-digit numbers with renaming

page 96 Problem 1 should provide practice and some smiles.

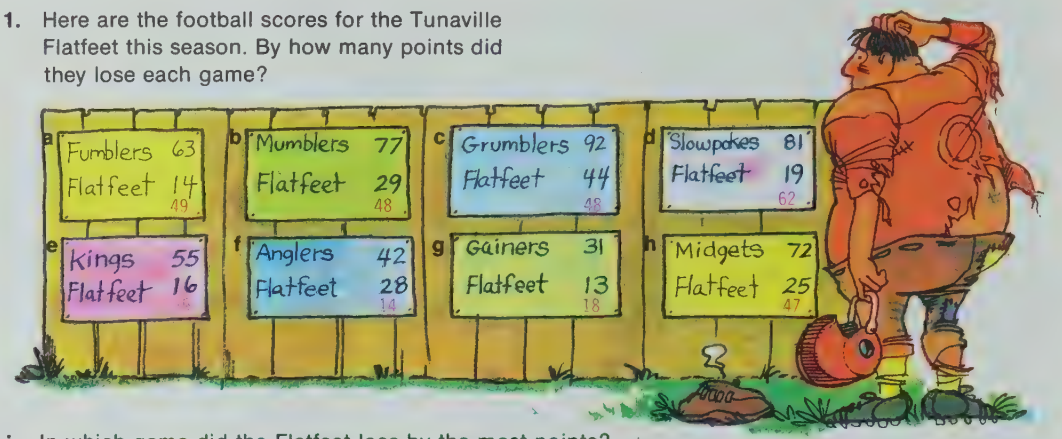
The Superstar set should be completed independently. Watch for trouble spots while correcting papers so that you can prescribe the appropriate additional help necessary. You will probably find three basic errors:

- Subtraction facts
- No renaming
- Renaming errors

Watch especially for—

$$\begin{array}{r} 43 \\ -29 \\ \hline 26 \end{array} \quad \text{Did not rename; reversed ones.} \qquad \begin{array}{r} 43 \\ -29 \\ \hline 24 \end{array} \quad \text{Did not rename tens.}$$

1. Here are the football scores for the Tunaville Flatfeet this season. By how many points did they lose each game?



i In which game did the Flatfeet lose by the most points? d
In which game did they lose by the least points? f

Are you ready? Get set. Go! Subtract.

	a	b	c	d
2.	31 − 17 = 14	72 − 43 = 29	55 − 28 = 27	47 − 39 = 8
3.	73 − 58 = 15	84 − 29 = 55	51 − 16 = 35	46 − 17 = 29

Now how many in all?

Answer depends on individual score.
Possible points: 8
Possible total score: 74

96

Answer each question.

Don't worry. The tax is already part of the price.

1. You bought a comb for 29 cents.
   You had 50 cents.
   Can you also buy a book for 21 cents? Yes

2. You got a loaf of bread for supper.
   That cost 35 cents. You had 75 cents.
   Can you also buy ice cream that costs 39 cents? Yes

3. You want to go to the movies. A ticket costs 65 cents. You can get a ride there, but you have to take a bus home. That costs 25 cents. You have 90 cents. Do you have enough money? Yes

These questions have to do with the clock.

4. You have 60 minutes before bedtime.
   You have to practice for 20 minutes.
   Do you have time to watch a 30-minute TV program? Yes

5. You know your homework will take more than 15 minutes. You are to be at a friend's house in 30 minutes. It takes 10 minutes to get there.
   Will you be late? Discuss—not if your homework takes less than 20 minutes.

6. You have one hour. You play for 45 minutes.
   How many minutes do you have left? 15 minutes

goal Application of subtraction

page 97 Not every pupil can profitably use this page. Use it as independent work for your confident pupils, and then you will have a chance to work with the ones who had trouble with page 96.

lesson Pages 98, 99, 100, 101

goal Examining subtraction of a 2-digit number from a 3-digit number

page 98 This review of place value and renaming numbers will be needed in order to expand subtraction skills. The size of the numbers involved in this lesson makes it difficult to use manipulatives as they were used in previous lessons. However, 12 bundles of sticks are a mighty effective way to convince pupils that 120 is 12 tens.

This page is strictly for discussion. Do not push writing. Pupils are being led through a sequential development on the road to independence. Go on to page 99.

three hundred forty-five

3 hundred 4 tens 5 ones → 345

345 could be named 34 tens 5 ones.

two hundred seventy-one

2 hundred 7 tens 1 one → 271

271 could be named 27 tens 1 one.

1. Rename as tens and ones.

a 125	**b** 196	**c** 205	**d** 164	**e** 111
12 tens, 5 ones	19 tens, 6 ones	20 tens, 5 ones	16 tens, 4 ones	11 tens, 1 one

Sometimes we use this idea when we subtract.

There are 123 cans of pop in all.
There are 12 cartons and 3 cans.
87 are sold. How many remain?

12 tens 3
− 8 tens 7
? tens **NO** You have to open a carton.

THIS IS WHAT YOU THINK

11 tens 13
~~12 tens 3~~
− 8 tens 7
? tens ?

THIS IS WHAT YOU WRITE

11 | 13
~~12~~ | ~~3~~
− 8 | 7
■ | ■
3 6

2. In which problems will you have to "open a carton of ten"?

a	**b**	**c**	**d**	**e**
13 | 5	18 | 4	16 | 7	15 | 8	14 | 2
− 7 | 8	− 9 | 1	− 3 | 4	− 3 | 9	− 6 | 5

You just decided *when* to rename a ten as ones in order to subtract. That is an important decision to make.

1. Don't subtract. Just tell how each number has to be renamed.

a	b	c	d	e	f	g
11 | 13	14 | 16	10 | 10	9 | 18	16 | 11	12 | 15	15 | 17
~~12~~ | ~~3~~	~~15~~ | ~~6~~	~~11~~ | ~~0~~	~~10~~ | ~~8~~	~~17~~ | ~~1~~	~~13~~ | ~~5~~	~~16~~ | ~~7~~
− 3 | 5	− 6 | 8	− 5 | 6	− 2 | 9	− 7 | 3	− 4 | 7	− 5 | 8

2. You should be ready to subtract. Try these.

13 | 12	12 | 10	9 | 14	17 | 15	14 | 17	11 | 14	16 | 11
~~14~~ | ~~2~~	~~13~~ | ~~0~~	~~10~~ | ~~4~~	~~18~~ | ~~5~~	~~15~~ | ~~7~~	~~12~~ | ~~4~~	~~17~~ | ~~1~~
− 8 | 4	− 4 | 7	− 2 | 5	− 9 | 6	− 7 | 8	− 3 | 5	− 9 | 6
5 | 8	8 | 3	7 | 9	8 | 9	7 | 9	8 | 9	7 | 5

3. Joe did three problems. He got three wrong. Look at his paper. Can you help him?

①	②	③
11 | 0	12 | 1	15 | 2
− | 3	− 4 | 7	− 7 | 5
11 | 3 X	8 | 6 X	9 | 3 X

TALK ABOUT THESE

a Think about cartons and cans again. 110 would be 11 cartons. No loose cans. Could Joe take 3 cans away if he didn't open a carton? No

b Look at the answer. 113 is more than the number to start with. Does that make sense? No

c What mistake did Joe make in ②? He subtracted 1 one from 7 ones.

d Did he make more than one mistake in ③? What are they?
Yes He subtracted 2 ones from 5 ones and incorrectly subtracted 15 − 7.

goal Examining subtraction of a 2-digit number from a 3-digit number

page 99 Have your pupils record as well as discuss the renaming step for row 1. Note that they do not have to compute.

Now let's put it all together! Row 2 is independent work. Circulate. Look for those who need additional help.

Talk about problem 3 together. It's easier to spot errors than to tell why the error happened.

goal Practice in subtracting a 2-digit number from a 3-digit number

warm-up More renaming practice may be needed by some pupils. Write this list on the board:

550	480
290	560
120	270

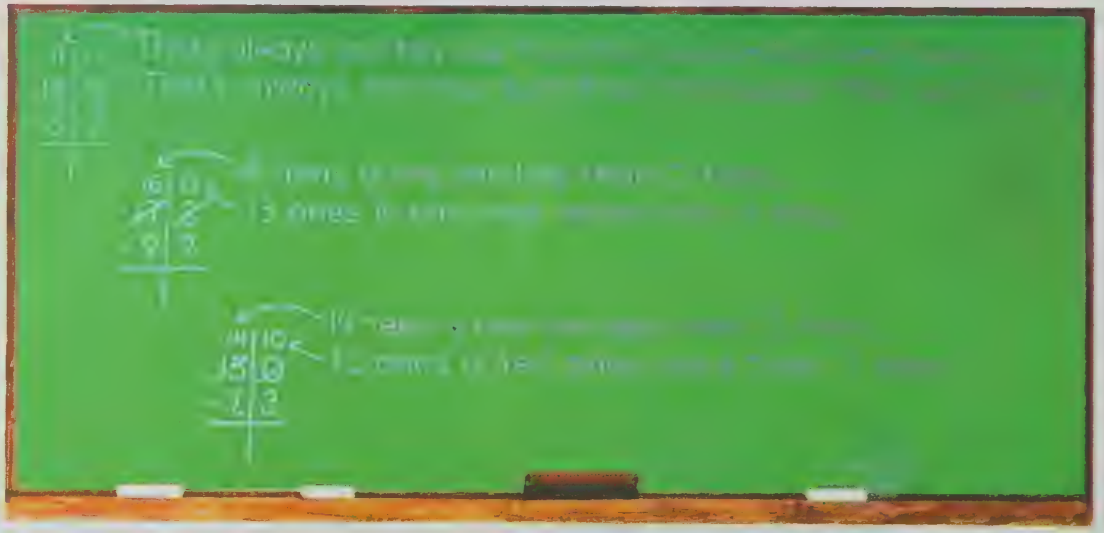
Which number has the most tens? Which has the least tens? Now have the pupils write the numbers from the greatest number of tens to the least.

Extend the activity with such numbers as 542, 385, 298, 456, 179. Rename them as tens and ones. Renaming is an essential skill for continued work in subtraction.

page 100 Be sure to stick with the model used in the text as you talk about Jan's idea. Very few children are aware that the **new** number on the left is **always** 1 ten less than the number that was there. This knowledge will allow renaming to become less of a mystery and more automatic. This information is especially helpful when problems involving zeros are introduced.

49	10	39	13
~~50~~	~~0~~	~~40~~	~~3~~
−25	6	−24	7

Jan did three problems. She thought she had a good idea that would help her rename for subtraction. She made out this sheet for you.



See if her idea works. Subtract these.

	a	b	c	d
1.	17 | 13 1~~8~~ | ~~3~~ − 9 | 5 8 | 8	14 | 16 1~~5~~ | ~~6~~ − 8 | 7 6 | 9	11 | 10 1~~2~~ | ~~0~~ − 5 | 2 6 | 8	13 | 12 1~~4~~ | ~~2~~ − 6 | 9 7 | 3
2.	15 | 14 1~~6~~ | ~~4~~ − 7 | 6 8 | 8	10 | 17 1~~1~~ | ~~7~~ − 4 | 9 6 | 8	12 | 11 1~~3~~ | ~~1~~ − 8 | 7 4 | 4	16 | 15 1~~7~~ | ~~5~~ − 9 | 6 7 | 9

100

Subtract. It's a Superstar set.

	a	b	c	d
1.	13 | 13 ~~14~~ | ~~3~~ − 7 | 7 6 | 6	11 | 18 ~~12~~ | ~~8~~ − 6 | 9 5 | 9	14 | 14 ~~15~~ | ~~4~~ − 9 | 5 5 | 9	15 | 12 ~~16~~ | ~~2~~ − 8 | 5 7 | 7
2.	16 | 12 ~~17~~ | ~~2~~ − 9 | 8 7 | 4	14 | 14 ~~15~~ | ~~4~~ − 7 | 5 7 | 9	13 | 15 ~~14~~ | ~~5~~ − 9 | 7 4 | 8	12 | 16 ~~13~~ | ~~6~~ − 8 | 8 4 | 8

What's your new total score?

Answers depend on individual score.
Possible points: 8
Possible total score: 82

3. Here are the basketball scores for the Tunaville Superstars. By how many points did they win each game?

a		
Superstars	144	
Hustlers	57	
		87

b		
Superstars	116	
Golddiggers	88	
		28

c		
Superstars	125	
Beavers	79	
		46

d		
Superstars	157	
Swingers	78	
		79

e		
Superstars	172	
Saints	93	
		79

f		
Superstars	140	
Satans	84	
		56

g		
Superstars	133	
Huskies	57	
		76

h		
Superstars	152	
Satellites	83	
		69

i		
Superstars	181	
Hotshots	92	
		89

j In which game did the Superstars win by the most points? i
In which game did they win by the least points? b

See activity 5, sets A and B, page 108b.

goal Identification of ability to subtract a 2-digit number from a 3-digit number with renaming

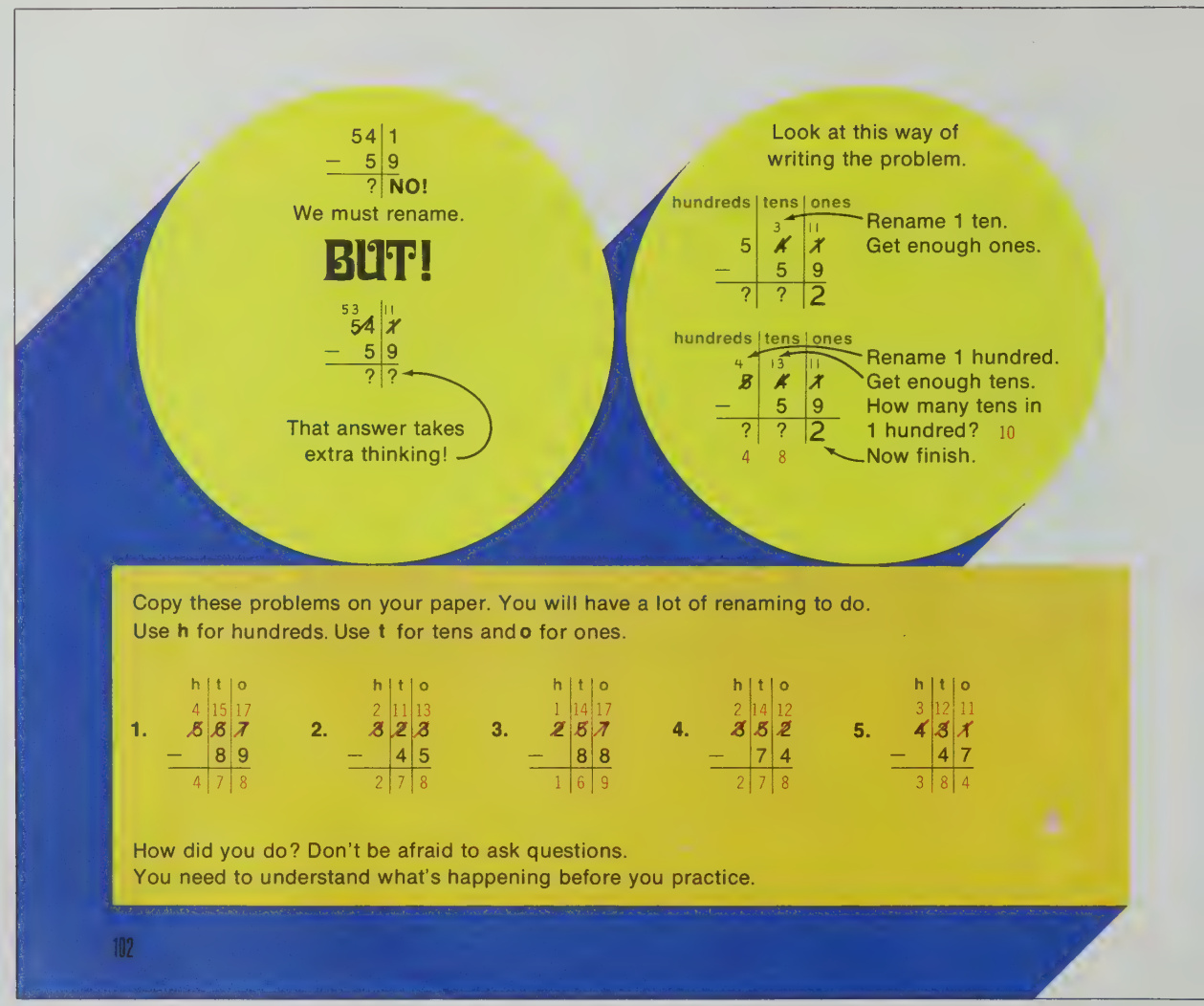
page 101 Review one or two examples. The Superstar exercise is independent work.

Use problem 3 as you help any pupils who are in trouble. You may want your sportsminded pupils to collect actual scores from their favorite pro basketball team's past record.

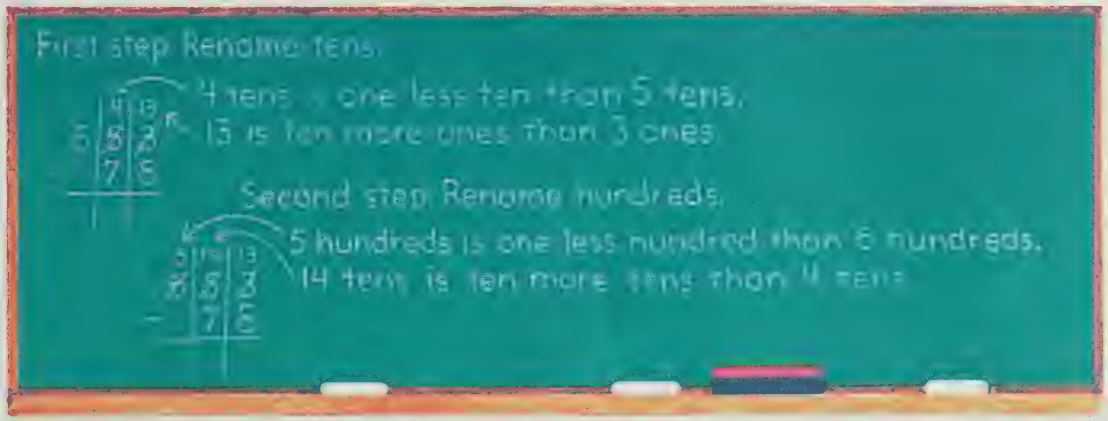
lesson Pages 102, 103, 104

goal Examining subtraction examples that require renaming tens and hundreds

page 102 It's time for togetherness again. All previous problems have required the learner to rename only once. The focus now is on renaming twice in the same problem. Instruct the pupils to proceed as the text suggests: First rename so that there are enough ones and then rename again so that there are enough tens. Have them practice with problems 1 through 5. Emphasize the last two lines of copy on the page.



Is Jan's idea of any use for problems like these?



Think about Jan's idea as you do these subtraction problems.

	a	b	c	d	e	f
	h t o	h t o	h t o	h t o	h t o	h t o
1.	3 11 16 ~~4~~ ~~2~~ ~~6~~ − 4 8 3 7 8	4 11 16 ~~5~~ ~~2~~ ~~6~~ − 5 7 4 6 9	2 11 14 ~~3~~ ~~2~~ ~~4~~ − 9 5 2 2 9	4 11 17 ~~5~~ ~~2~~ ~~7~~ − 6 8 4 5 9	6 12 16 ~~7~~ ~~3~~ ~~6~~ − 4 8 6 8 8	1 12 17 ~~2~~ ~~3~~ ~~7~~ − 8 9 1 4 8
	h t o	h t o	h t o	h t o	h t o	h t o
2.	1 14 16 ~~2~~ ~~5~~ ~~6~~ − 5 7 1 9 9	2 15 12 ~~3~~ ~~6~~ ~~2~~ − 9 9 2 6 3	3 16 15 ~~4~~ ~~7~~ ~~5~~ − 9 6 3 7 9	4 9 13 ~~5~~ ~~0~~ ~~3~~ − 7 5 4 2 8	4 13 13 ~~5~~ ~~4~~ ~~3~~ − 6 4 4 7 9	5 13 10 ~~6~~ ~~4~~ ~~0~~ − 5 7 5 8 3

goal Subtraction practice with renaming

page 103 Review examples are provided. The step-by-step sequence should help. Check on progress after the first row of problems is completed. Adjust the remainder of the assignment to meet individual pupil needs.

goal Review of the types of subtraction developed in the chapter; identification of skill

page 104 Use problems 1 through 12 to review the concepts and skills developed in the chapter. Problems 13 and 14, the Superstar set, are independent work. Notice that there is no renaming in the ones place in this set. These problems will clearly show those pupils who can be expected to master subtraction of a 2-digit number from a 3-digit number and those who probably will have trouble. For those in trouble, provide individual help. Meanwhile, youngsters who are operating confidently can go on to extension pages 106 and 107.

Practice some more. Show all your work on your paper.

1. 14 − 7 = 7
2. 1 14; ~~2~~ ~~4~~ − 7 = 1 7
3. 1 14; ~~2~~ ~~4~~ 0 − 7 0 = 1 7 0
4. 1 14; ~~2~~ ~~4~~ 9 − 7 6 = 1 7 3
5. 16 − 8 = 8
6. 3 16; ~~4~~ ~~6~~ − 8 = 3 8
7. 3 16; ~~4~~ ~~6~~ 0 − 8 0 = 3 8 0
8. 3 16; ~~4~~ ~~6~~ 7 − 8 4 = 3 8 3
9. 12 − 9 = 3
10. 6 12; ~~7~~ ~~2~~ − 9 = 6 3
11. 6 12; ~~7~~ ~~2~~ 0 − 9 0 = 6 3 0
12. 6 12; ~~7~~ ~~2~~ 6 − 9 1 = 6 3 5

Now try these problems.

	a	b	c	d
13.	2 14; ~~3~~ ~~4~~ 2 − 7 1 = 2 7 1	6 12; ~~7~~ ~~2~~ 3 − 3 2 = 6 9 1	3 14; ~~4~~ ~~4~~ 9 − 7 7 = 3 7 2	4 11; ~~5~~ ~~1~~ 6 − 7 3 = 4 4 3
14.	8 13; ~~9~~ ~~3~~ 7 − 8 2 = 8 5 5	3 10; ~~4~~ ~~0~~ 8 − 7 5 = 3 3 3	5 15; ~~6~~ ~~5~~ 4 − 9 3 = 5 6 1	7 14; ~~8~~ ~~4~~ 3 − 5 1 = 7 9 2

You are getting closer. **What total today?**
Answer depends on individual score.
Possible points: 8
Possible total score: 90

Subtract. Show all your work on your paper.

1. 14 − 8 = 6

2. 34 − 8 = 26

3. 340 − 80 = 260

4. 345 − 86 = 259

5. 12 − 7 = 5

6. 52 − 7 = 45

7. 520 − 70 = 450

8. 523 − 79 = 444

9. 14 − 9 = 5

10. 84 − 9 = 75

11. 840 − 90 = 750

12. 841 − 98 = 743

Try working these problems.

	a	b	c	d
13.	723 − 59 = 664	287 − 99 = 188	305 − 76 = 229	647 − 79 = 568
14.	543 − 94 = 449	478 − 99 = 379	213 − 65 = 148	743 − 74 = 669

What's your new total?

Answer depends on individual score.
Possible points: 8
Possible total score: 98

lesson Page 105

goal Review of the types of subtraction developed in the chapter; identification of skill in subtraction with renaming

page 105 Bring your groups back together and look at the pattern in problems 1 through 12 **before** you ask the pupils to complete them. If your pupils are having trouble, collect the papers and correct them to discover any errors that may show up. You will be able to help, either individually or in a small group, those children who are having trouble before they do the Superstar set.

If there is no trouble, go on to the Superstar set. It should be completed independently.

lesson Pages 106, 107

goal Application of subtraction

memo Pages 106 and 107 are extension pages. Use them as time and ability permit.

page 106 If spelling is a problem, have the youngsters draw a picture to fill in the blank.

It was a busy little store. You decide what things they sell. You figure out how many they have to sell.
[redacted] is your choice. Any word can be chosen.

1

They had 144 packages of [redacted]. They sold 55. How many packages of [redacted] do they have left? 89

2

They ordered 250 [redacted]. 26 got broken. How many [redacted] do they have to sell? 224

3

They had too many [redacted]. 753 in all. They had only sold 38. They wanted to get rid of all of them. How many [redacted] did they put on sale? 715

4

Somebody made a mistake. They ordered 125 [redacted]. They got 736. How many [redacted] too many did they get? 611

5

There were 175 [redacted] on the counter. Clumsy Clancey spilled water. Only 138 didn't get wet. How many [redacted] did Clumsy Clancey ruin? 37

6

They had 350 [redacted]. Somebody wanted 425. How many more [redacted] did they need? 75

1 Complete the subtraction puzzles. Subtract the number on the left from each number across the top.

a

–	93	714	155
64	29	650	? 91
27	? 66	? 687	? 128
48	? 45	? 666	? 107

b

–	127	85	541
36	? 91	? 49	? 505
54	? 73	? 31	? 487
79	? 48	? 6	? 462

2 Answer the questions.

a 45 yards to the goal line.
There was a 37-yard run.
How many yards to go now? 8

b The ball goes back 15 yards on a penalty.
How many yards now? 23

c There was a 20-yard completed pass.
Did the team score? Not yet! 3 yards to go!

goal Subtraction practice in puzzle form.

page 107 Once directions are discussed, pupils work independently.

Problem 2 is appropriate for the pupils who are having trouble. They can draw a picture to help them through the reasoning part.

lesson Page 108

goal **Checkout**—identification of ability to subtract with renaming

page 108 Everyone is on his own on this page. Watch for the types of errors made so that you can give the proper help. Present Superstar certificates to pupils who earned at least 100 points. (See the Resource Section, page 144h.)

If facts are a problem, identify the specific facts the youngster must still master. Give him an opportunity to earn some Superstar points.

Have those who made renaming errors explain the steps to you. Listen for clues to faulty or incomplete understanding. More practice won't help unless you first get to the root of the trouble.

CHECKOUT

Can you work these problems without making mistakes? Try it.

Skill: 2-digit minus 1-digit numbers renaming tens

1. 4 12 / 5 2 / − 6 / 4 6

2. 2 11 / 3 1 / − 8 / 2 3

3. 6 14 / 7 4 / − 5 / 6 9

Skill: 2-digit minus 2-digit number, renaming tens

4. 5 14 / 6 4 / − 2 9 / 3 5

5. 6 12 / 7 2 / − 1 7 / 5 5

6. 7 14 / 8 4 / − 5 9 / 2 5

Skill: 3-digit minus 2-digit number, renaming tens

7. 11 14 / 12 4 / − 8 5 / 3 9

8. 13 17 / 14 7 / − 9 8 / 4 9

9. 12 11 / 13 1 / − 6 5 / 6 6

Skill: 3-digit minus 2-digit number, renaming hundreds

10. 2 11 / 3 1 6 / − 7 2 / 2 4 4

11. 8 14 / 9 4 3 / − 7 1 / 8 7 2

12. 4 15 / 5 5 6 / − 6 2 / 4 9 4

Skill: 3-digit minus 2-digit number, renaming tens and hundreds

13. 3 13 15 / 4 4 5 / − 9 7 / 3 4 8

14. 2 11 14 / 3 2 4 / − 5 5 / 2 6 9

15. 4 10 17 / 5 1 7 / − 7 8 / 4 3 9

Do you have the 100 points you needed? If you don't, you can still earn them.

Answer depends on individual score.
Possible points: 15 Possible total score: 113

108

See activity 6, page 108b.

See activity 7, page 108b.

RESOURCES

another form of evaluation

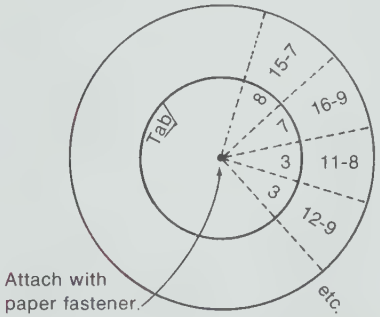
for Checkout—page 108
Have you reached your goal? Can you prove your skills in subtraction. Try these and see.

1.	4 − 6 = 3	2 − 6 = 6	2.	5 − 7 = 4	1 − 7 = 4	3.	7 − 7 = 6	6 − 7 = 9
4.	6 − 3 = 2	2 − 7 = 5	5.	8 − 4 = 3	2 − 9 = 3	6.	7 − 2 = 4	1 − 8 = 3
7.	13 − 7 = 5	5 − 7 = 8	8.	15 − 8 = 6	6 − 7 = 9	9.	14 − 7 = 6	1 − 6 = 5
10.	2 − 7 = 1	1 − 1 = 4	6 − 7 = 6	11.	8 − 9 = 7	3 − 2 = 4	4 − 2 = 2	12.	6 − 8 = 5	6 − 5 = 0
13.	5 − 5 = 4	5 − 7 = 9	2 − 5 = 5	14.	4 − 9 = 3	9 − 8 = 9	7 − 8 = 9	15.	7 − 9 = 6	8 − 8 = 8

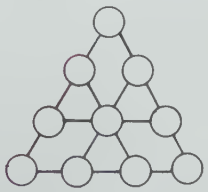
activities

1. things 9″ fluted-edge paper plate. 6″ paper plate, felt pen, paper fastener

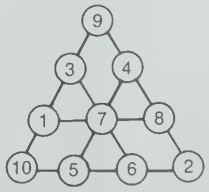
Mark the center of the 9″ plate. Around the edge of the plate write facts that a pupil has not yet mastered. Move in 4 inches from the edge and write the answer. These answers should be on an imaginary line from the center of the plate to the problem. Cut a tab in the rim of the 6″ plate and leave the tab attached to form a hinge. Center the 6″ plate over the 9″ plate and attach with a paper fastener. Turn the small plate so that the tab is opposite a problem. The tab is lifted to verify answers. Adapt for any type of fact practice necessary.



2. Use only the numbers 1 through 10. Write one number in each circle so that the sum of each line with four circles is the same **and** the sum of each line with three circles is the same.



Answer

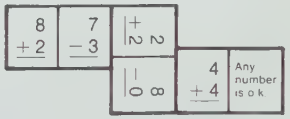


3. things subtraction fact cards (no answers visible), small box, markers

Help pupils fold a piece of paper into 9 spaces to form a 3-by-3 grid. Have them write the numbers 1 through 9 in random order in the 9 space. Eliminate all facts that have a difference of zero. Mix the remaining cards in the small box.

One pupil serves as caller, drawing a fact card from the box and reading it. If the difference appears on their sheet, the players cover it with some sort of marker. A row across, a column down, or a diagonal covered wins the game. Drawn cards are not returned to the box; they can be used to verify covered answers in case of a dispute.

4. things index cards, felt pen
Cut index cards in half lengthwise. Prepare cards as shown below. Mix addition and subtraction facts. The cards are shuffled. One card is dealt to each player. The other cards are spread out facedown. One card is then turned faceup to begin play. Each player in turn plays his card if he can match an answer. If not, he selects a facedown card, continuing until he has one he can play. The game continues until all the cards are played.



5. Knowing when to rename and how to rename are prerequisite skills for mastering subtraction with renaming. The sets of problems shown below can be copied on a spirit master. Cut the sets apart to meet individual practice needs.

Set A Ring the problems that require renaming.

24	36	83	27
− 8	− 4	− 8	− 9
46	56	35	51
− 28	− 27	− 25	− 15

Go back. Show the renaming.
DO NOT SUBTRACT.

Set B Ring the problems that require renaming.

523	347	420
− 19	− 56	− 13
421	429	641
− 246	− 386	− 256

Go back. Show the renaming.
DO NOT SUBTRACT.

6. things 4 wood cubes

Write a numeral on each face of the cubes as follows:

- 1-digit numerals on 1 cube
- 2-digit numerals on 2 cubes
- 3-digit numerals on 1 cube

Select a pair of cubes to provide the type of practice needed. In turn, a player rolls the cubes and finds the difference of the numbers that land faceup. He earns 2 points for a correct answer or loses 1 point for an incorrect answer. If the player catches his own error, he earns 2 points as for a correct answer. The players predetermine the number of points needed to win.

7. things game board; 25 small cards

Prepare a game board as shown. Vary the numbers used to meet the abilities of your pupils.

−	98	64	87	75	68
33					
45					
23					
51					
26					

Write one of the differences on each small card. These cards (tiles) should be the same size as the empty boxes on the game board.

Turn the answer tiles facedown in random order. Each player selects 4 tiles. The first player places an answer tile on any box for which the numeral on the tile is the difference. Each succeeding player then attempts to place a tile on the board so that it shows a correct difference and touches vertically or horizontally the tile played previously by another player. If a player does not have a tile he can play, he draws from the facedown tiles until he finds one he can use. The winner is the first player to use all his tiles.

additional learning aids

operation—chapter objectives 1, 2, 3

SRA products

Arithmetic Fact Kit, SRA (1969)
Subtraction cards: 26, 27
Cross-Number Puzzles (Whole Numbers), SRA (1966)
Subtraction cards: 2, 4, 5, 6, 11
Computapes, SRA (1972)
Module 2, Lessons: AS 33, 34, 35
Mathematics Involvement Program, SRA (1971)
Card: 104
Skill through Patterns, level 3, SRA (1974)
Spirit masters: 28, 45, 46, 47
Visual Approach to Mathematics, level 3, SRA (1967)
Visual: 11

other learning aids (described on page 144i)—Abacus board, Counting chips, I Win (sets 1 and 2), Mathfacts Games (levels 3 and 4), Orbiting the Earth (subtraction), Quizmo (add-subtract), Stamina, Unifix Mathematics Kit, Veri-Tech Senior (addition and subtraction books)

6 GEOMETRY SYMMETRY

before this chapter the learner has—

1. Sorted a set of geometric shapes by likenesses and by differences
2. Traced shapes and cut out the tracings

in chapter 6 the learner is—

1. Determining which shapes fit together well to cover an area
2. Identifying squares and other rectangles
3. Testing for square corners with a square-corner tester
4. Determining the line(s) of symmetry by folding a paper model
5. Determining whether a figure on graph paper is symmetrical

in later levels the learner will—

1. Master showing line(s) of symmetry by folding
2. Find the area of a region
3. Determine whether two figures are congruent

Notes & Things

This geometry chapter builds on the experiences the pupils had in chapter 4. The pupils have seen and worked with two-dimensional figures taken from three-dimensional shapes. This chapter includes still more plane figures. There is no need to worry about the names for these plane figures. It's enough to see that some have straight sides, some have a curved side, and some have both. Some of the figures with straight sides have 3 sides, some have 4 sides, and some have more. It would be a real bonus if several children would recognize that sometimes the straight sides are the same length, even though that idea is not featured in this chapter.

The featured idea is symmetry. *Exploration* is the big word. The children will learn by experimenting. They will arrive at their own conclusions as they go through a set of sequenced activities. They will find what kind of shape best fits together to cover a surface. This activity will not only provide readiness for the concept of area studied in a later level but also let the pupils learn some of the characteristics of plane figures. They will trace, cut, and fold shapes to find whether a plane figure is symmetrical. They will see the idea of symmetry in nature and in things made by people and machines. All the answers are not obvious. The possibility of more than one answer is also considered. The pupils are challenged to THINK!

Geometry chapters are always a favorite of children and this one should be no exception. This chapter will give you a beautiful opportunity to incorporate art class into math time. Some good bulletin boards will also result from the activities. Maybe this chapter will be a favorite of yours too.

things

paper for tracing
scissors
empty cans
plain paper
tempera paint
1″ wood cubes, waxed paper, and graph paper—optional

For the extra activities you will want to have a mirror available.

goal Think about and explore ideas through a picture clue

page 109 The photograph that opens the chapter on symmetry could have been a building or an automobile, but it seemed much more fun to show the zebra.

The theme of your questions should be the idea of symmetry in nature. The stripes on the zebra are a long way from being perfectly symmetrical, but the idea is there. *Would it be easy to see the difference between the stripes on the left side of the zebra and those on the right side if you could see only one side at a time? If you looked at the right side, would you suppose the left side would be the same?*

Now suppose you were looking at a butterfly. Would you have a better change of seeing both sides at the same time? What would you see if you looked at both wings? On what other things could you see that the left side looks very much the same as the right side? What things are the same? Color? Markings? Size? Shape? Do you suppose the two sides are exactly the same?

Now you have the opportunity to begin some individual independent projects. The pupils can start something as simple as a list of things they see that have one side the same as the other side. Or a picture collection would be great. For those youngsters who love to paint and have a wild imagination, have them create their own zoo with fantastic animals that look nothing like the animals you could expect to see in any real zoo.

lesson Pages 110, 111, 112

goal Exploring the use of square and rectangular regions to make a figure

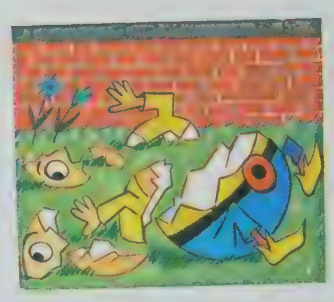
memo These are exploratory pages and are basically self-explanatory. The children are directed to trace and to cut out various figures and then try to do different things with the figures. They will be learning while **doing.** They will want to talk about their discoveries. Discussion is an important step in the learning process.

Youngsters of this age level generally have the coordination necessary to perform these activities; however, some will need help in doing the activities as directed. You may want to prepare a spirit master of the figures to eliminate the tracing step.

things paper for tracing
scissors
1″ wood cubes (optional)

page 110 Pupils can easily trace 1 or 2 one-inch cubes to make a set of square and rectangular shapes as pictured in the text. You might even try fitting actual cubes together. When manipulated, the pieces make a square or rectangular region or a straight-sided figure. Encourage the pupils to find all of these possibilities.

They'll need these square and rectangular shapes again for page 111.



Humpty Dumpty had a great fall.
All the king's horses and all the king's men,
Couldn't put Humpty together again.

Had Humpty been a squarehead rather than an egghead, he might have been put together again.

In the set of pieces—

1. How many different sizes are there? 2
2. How many small pieces would cover one of the bigger pieces? 2
3. Find pieces that are like these. Fit them together. What shapes can you make? Discuss: rectangles, squares, and other square-cornered, straight-sided shapes such as

Are you ready to explore some new ideas? You will fit together and fold all sorts of shapes. Your goal is to make some discoveries about flat shapes you see all around you all the time.

110

1. Do you think shapes like this would fit together? Trace, cut, and try it. No

2. Would these shapes fit together? Yes
Trace, cut, and try it.

Use some of the same pieces you used before. You'll need both rectangles and squares. Can you fit them together so that they form a rectangular shape that is not a square? Try it!
Yes

LOOK AROUND YOU

Can you find squares or rectangles that fit together to make a larger shape? Discuss results.

Look at school!	Look at home!
How about— the windows? the floor? the ceiling?	What about— the kitchen? the bathroom? the bedroom?

Look when you go to the store.
Look when you walk home.

Keep a record of all the different patterns you find.

goal Exploring the use of various shapes to cover a region

things paper for tracing
scissors

page 111 Through discussion, bring out the similarity of the children's activities in fitting together shapes and the use of such shapes in tile patterns (floor, ceiling, ceramic), sidewalk blocks, window panes, and so on.

There may be too much tracing and cutting. Let each pupil pick one of the shapes to work with. Then he can share his findings with those of pupils who picked an alternate shape.

Save the models. Some youngsters may need them for page 112.

goal Discovering some characteristics of rectangles and squares

things models from previous pages

page 112 Please don't expect the real name for the parallelogram, rhombus, or hexagon. Accept a good descriptive label and let it go at that.

If the children aren't sure which shapes would fit together best, take out the little models again and work with them. Decisions for the next several pages should be based on experience, not on a guess or on being told. Sort the shapes: those that fit together best form one group; those that do not, form another. Some shapes make interesting designs, but do not fit together well enough to cover an entire area. Holes are left between. Sorting the shapes will help the children focus on likenesses and differences. Exercise 6 could be summarized in a large chart, with new information added as it is discovered.

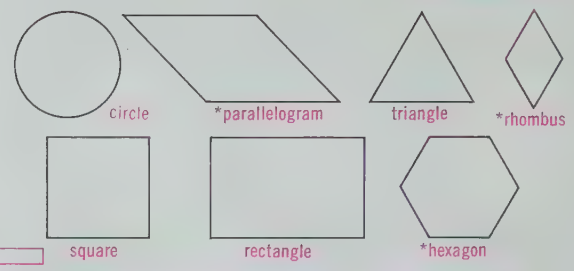
Talk about this page.

*Don't expect answers.

1. Which shapes do you think would fit together best? Can you name them?

2. What is alike about the shapes that fit together best? Straight sides, corners

3. Which shapes can be put together to make a rectangular shape? Prove it.
Squares and rectangles Examples:



4. How many squares? 8

5. How many rectangles? 6

6. What about these?

a How are the squares and rectangles alike? 4 sides, opposite sides same length, 4 square corners

b How are they different? Square: all sides same length Rectangle: opposite sides same length

c Can a square be a different size and still be a square? Yes

d Can a square be a different shape and still be a square? No

e Can a rectangle be a different size and still be a rectangle? Yes

f Can a rectangle be a different shape and still be a rectangle? No

112

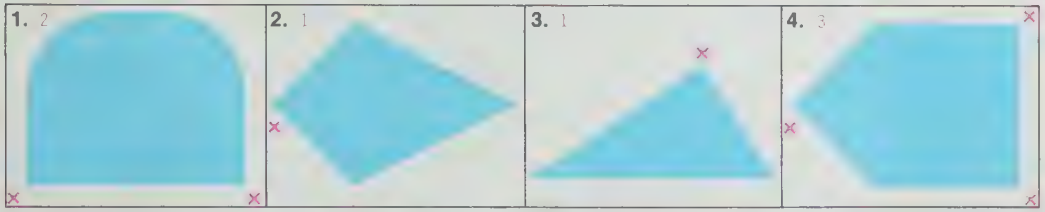
You can find square corners in other shapes, too.
First you have to have something to test a corner to make sure that it is square. Find a small sheet of paper.

Fold it.

Now fold again so that the fold goes over on itself **AND** now you have a square-corner tester.

How many corners does this shape have? 3
How many square corners? Slide your tester into each corner.
Does any corner match the tester? Yes

Try your square-corner tester here.
How many square corners in each shape?



5. Unfold your tester. How many square corners can you find where the fold marks are? 4

lesson Page 113

goal Testing for square corners with a square-corner tester

things paper
waxed paper (optional)

page 113 When making a square-corner tester, the first fold in the paper can be anywhere, in any direction. However, the second fold must be made so that the first fold goes over and lies on itself. After finding the square corners, test for corners that are greater than and corners that are less than a square corner. Try testing objects in the room—desk, table, bookshelves, and so on.

Waxed paper makes an excellent tester. It is both easy to fold and translucent. The youngster is able to see the lines in the book through the tester and determine whether the corner is less than a square corner.

lesson Pages 114, 115, 116, 117

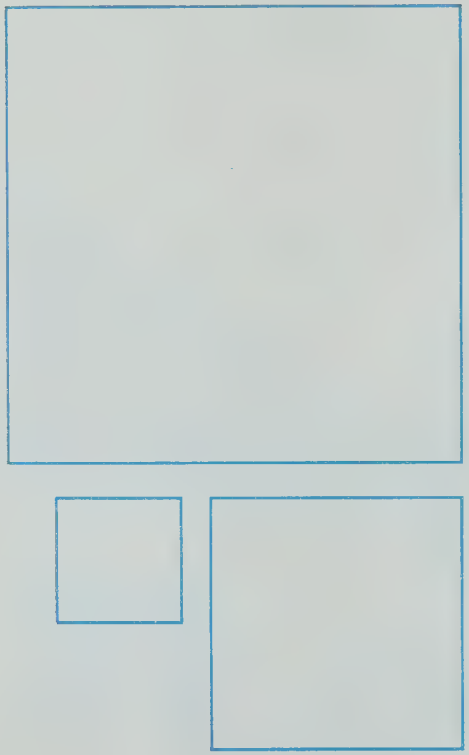
goal Readiness for finding lines of symmetry

things paper for tracing
scissors
empty cans

page 114 Large figures are easier for the youngsters to handle. Some children are content to fold a figure once and feel that they have followed the directions. Praise those who experiment and find yet another way. Discuss the ways that did not work. Compare the number of ways a square and a rectangle can be folded so that the halves match.

Have the children trace circles of various sizes. Does size affect the possible number of folds? Encourage the children to continue folding. Is there any end? Don't tell them—let them find out for themselves.

Youngsters who lack coordination may make models that are not symmetrical even though they are supposed to be. If the children's answers do not agree with the answer key for this reason, accept the answers. Do not make a point of their lack of coordination. Rather, provide additional tracing and cutting activities to help develop these skills. Thin tracing paper, which can easily be folded without first cutting out a figure, might also be used. Be aware, however, that this presents other coordination problems.



A rectangle has four square corners. The opposite sides of a rectangle are the same length. What about the length of the sides of a square? All have equal lengths.

1. Measure each side of each square.

What is true about the length of each side of a square?
It's the same length as the others.

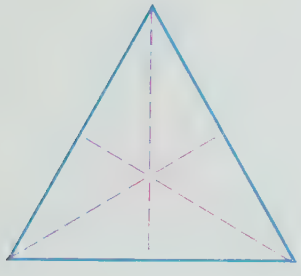
2. Trace the square that has the longest side. Cut out the square.
   a Can you fold it so that one half matches the other half? Yes
   b Can you fold it another way so that one half matches the other half? Yes: How many ways can you find in all? 4:

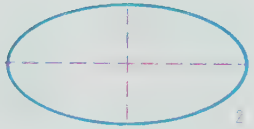
3. Find a large rectangle that is not a square. Trace it. Cut it out. How many ways can you find to fold this shape so that one half matches the other half? 2:

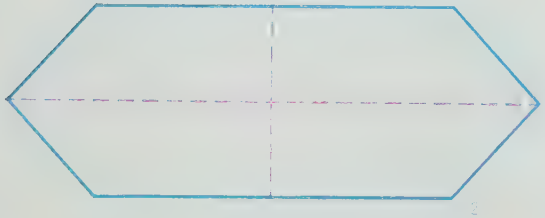
4. Find a jar or can. Draw around the circular face. Cut out the shape. This is a big job. How many ways can you find to fold it so that one half matches the other half?

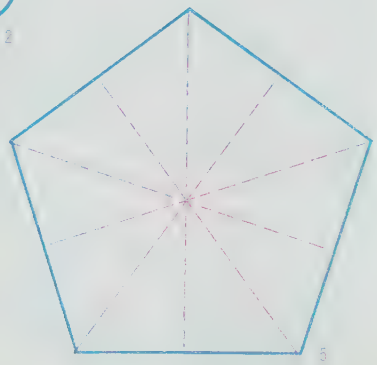
Infinite number of ways

Trace each one of these shapes. Cut each out. How many different ways can you find to fold each of these so that one half matches the other half?









When you can fold a shape at least once so that one half matches the other half, you can say the figure has *symmetry*. The fold line is called the *line of symmetry*.

goal Introduction to the concept of symmetry

things paper for tracing
scissors

page 115 Again encourage the spirit of experimentation. Try—perhaps it will work, perhaps it won't. The parallelogram can be cut in half and rearranged into a symmetrical figure. Not now—this is the work of a later level. As given, the figure cannot be folded so that it is symmetrical.

Children love new and unusual words. Introduce SYMMETRY and LINE OF SYMMETRY, but do not belabor the mastery of this terminology. It's the concept that counts: some figures have matching halves; some do not. We can fold to find a line that divides a figure into matching halves. Some figures have only one such fold; others have more than one.

goal Producing a symmetrical figure

things plain paper
tempera paint

memo Why not combine math and art class today? You'll need the extra time.

page 116 Warning—one drop of paint will do; more can make a mess! Figures cut from colorful construction paper, together with the paint designs, create a decorative room. Things happen with this kind of an activity—the paper slips and the paint runs. The result is a nonsymmetrical figure. No one is at fault. It simply happens. Discuss whether the results **are** or **are not** symmetrical.

116

You will need pieces of plain paper and some kind of paint or ink such as you use in art class.

Fold the paper so that one half matches the other half.

Open the paper.

Put *one* big drop of paint somewhere close to the middle *on* the fold mark.

Close the paper quickly. Rub the paper about where the drop of paint is.

Open the paper. The paint has made a design.
Does the design have symmetry? It should have.
Can you find the line of symmetry? Where is it? The fold line
Yes

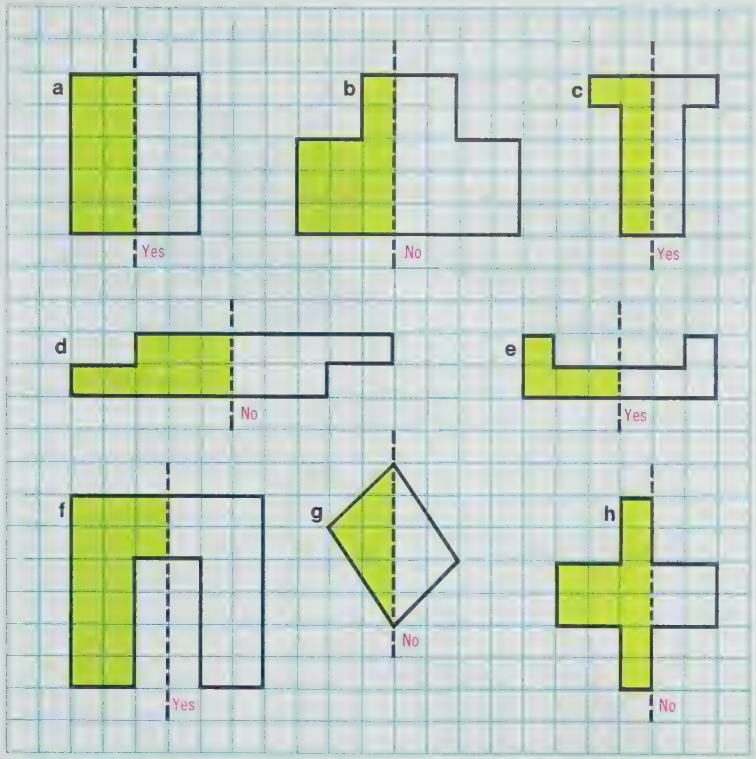
You can make many beautiful designs with just one drop of paint on the fold of paper.

You can make many designs with just paper and scissors. Try this.

Find some more plain paper. Fold the paper so that one half matches the other half. Keep the paper folded. Cut out a shape. Make sure you don't cut all the folded edge. Open the paper. Look at the hole. Open the cut-out piece.

Can you find the line of symmetry? Yes—the fold line
Does the cut-out piece fit back into the hole? Yes
Is there still a line of symmetry? Yes

Part of a figure is outlined. Part is shaded. The dotted line is a pretend fold line. The graph paper will help you decide if the outlined part matches the shaded.



goal Identifying figures that have symmetry

things graph paper (optional)

page 117 Counting will help pupils determine whether or not the halves match. If you have graph paper available, encourage them to make designs of their own. Coloring each half a different color will emphasize the line of symmetry (if there is one).

things mirror

Hold a mirror along the line of symmetry of a symmetrical figure. Have a youngster look in the mirror. *Does the picture in the mirror match the picture on the paper? Do the two halves match?*

lesson Page 118

goal Relating symmetry to the real world; **Checkout**—naming things that have symmetry

page 118 Many things in nature appear to be symmetrical. Close examination will prove that they are not. Only man-made objects are truly symmetrical. People observed the **matching** halves in nature, perfected the idea, and gave it a name—symmetry.

One test for symmetry is to trace and fold. Several children may try this technique to verify their visual judgments. Examine the large X. Does it have a line of symmetry? Only one? Encourage the pupils to look for examples of symmetry—knitting or embroidery patterns, fabric patterns, wallpaper designs.

Analyzing why a thing is not symmetrical is as important as being able to determine that another object is symmetrical. This is not a mastery objective, but it is good training for critical thinking.

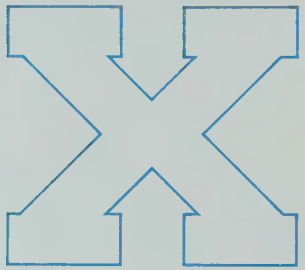
You might consider having the youngsters make small sketches for the Checkout, rather than write. You'll want them to share their ideas.

TALK ABOUT THESE.

There are many things around you that have symmetry.

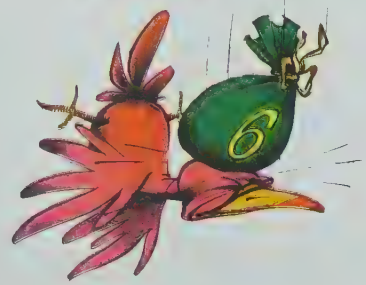
Have you ever seen a butterfly? It looks as if it has symmetry.

This is a leaf. It looks as if it has symmetry.



Here is a letter of the alphabet. It looks as if it has symmetry.

CHECKOUT



LOOK AROUND YOU!

Skill, Finding shapes that have symmetry.

List ten things that have symmetry.

Think about—

- things in school. Open book, some letters of alphabet A, H, E, C, M, Valentine heart
- things at home. Dining room table, chair, sofa
- shapes of things that grow. Sunflower, leaves, snowflake, pear or orange — cut in half
- shapes of buildings. Some schools—door in middle, same number of windows on each side
- shapes of people too. Face, whole body

118

See activity 1, page 118a.

See activity 2, page 118a.

RESOURCES

another form of evaluation

for Checkout—page 118
LOOK AROUND YOU!

Lots of things have symmetry. Draw 10 things that do. Think about— Answers will vary. Examples are given.

- Things in the gym Basketball
- Things in a grocery store Cereal box
- Things that grow Orange
- Tools Screwdriver
- Pictures or paintings you've seen

activities

1. things shapes cut from paper (see next page for ideas)—some symmetrical
some not symmetrical

The shapes should show no fold marks or possible lines of symmetry. *Can you fold the shape you have so that the 2 halves match? Can you find more than one way to make such a fold?*

2. things soft-lead pencils, paper

Fold the paper in half. Now open the paper flat. Make a design on one side up to the fold, but not past the fold. Refold the paper along the line. Rub the paper. The design will print on the other half of the paper. Open the paper again. *What kind of figure have you made?*

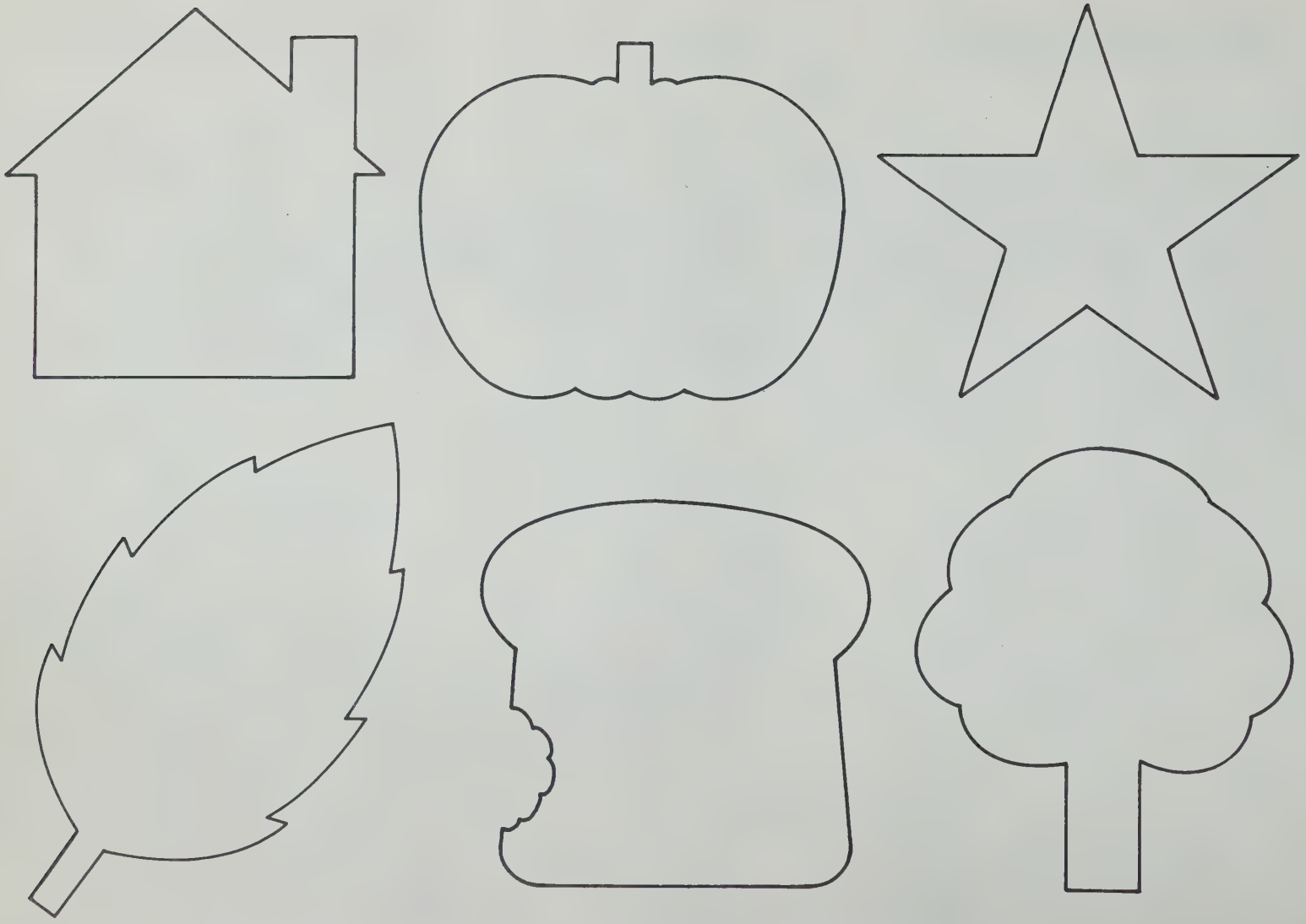
additional learning aids

concept—chapter objectives 1, 2, 3, 4, 5

SRA products

Mathematics Involvement Program, SRA (1971)
Cards: 243, 263, 244, 75, 105, 265
Skill through Patterns, level 3, SRA (1974)
Spirit masters: 40, 60, 62

other learning aids (described on page 144i)—
Geoboard Activity Cards (primary and intermediate sets), Geoboard Kit, Learn to Fold—Fold to Learn, Mira, Mira Math for Elementary School, Tangramath, Tangrams



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7 MULTIPLICATION

before this chapter the learner has—

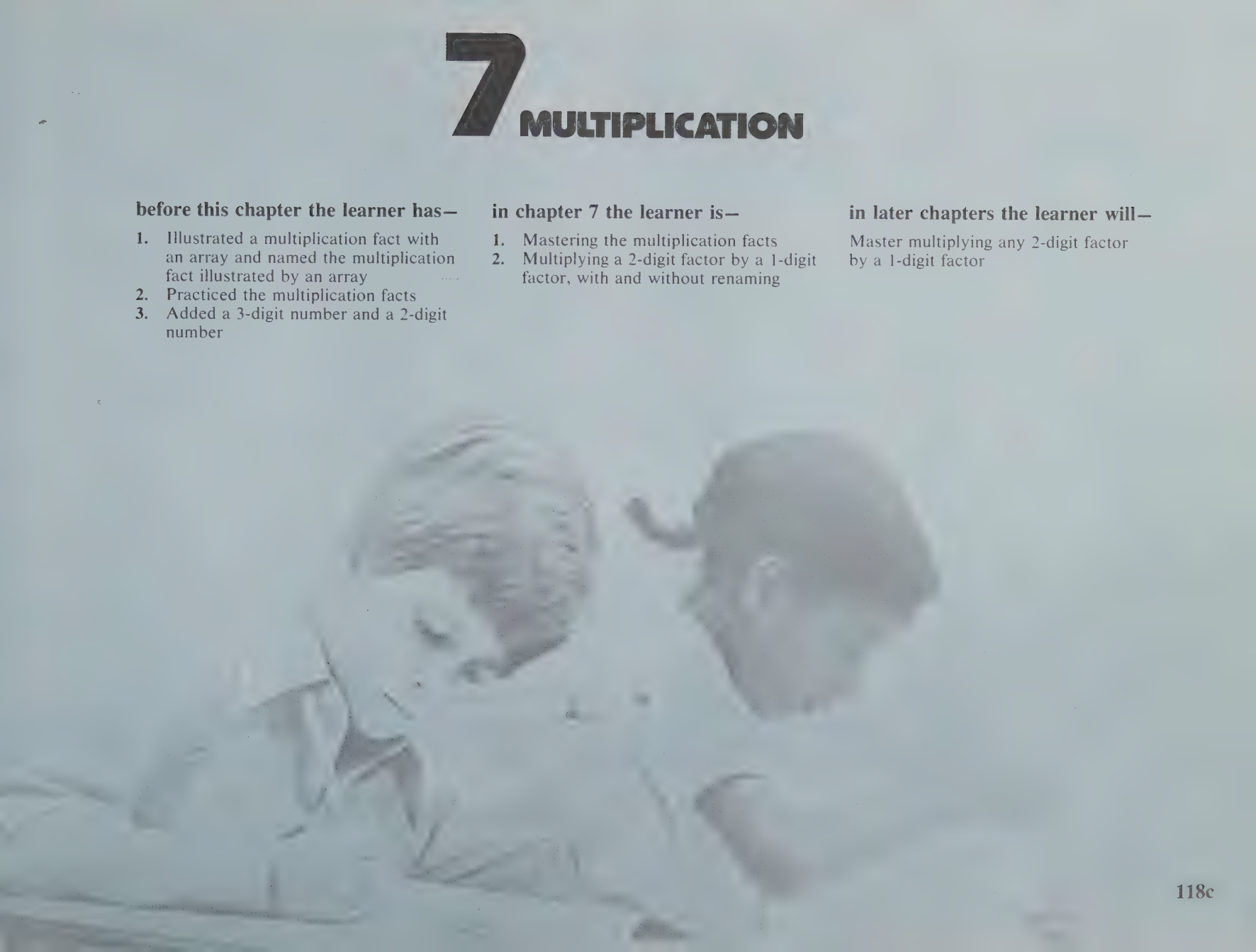
1. Illustrated a multiplication fact with an array and named the multiplication fact illustrated by an array
2. Practiced the multiplication facts
3. Added a 3-digit number and a 2-digit number

in chapter 7 the learner is—

1. Mastering the multiplication facts
2. Multiplying a 2-digit factor by a 1-digit factor, with and without renaming

in later chapters the learner will—

Master multiplying any 2-digit factor by a 1-digit factor



Notes & Things

It will be hard to predict how much time this chapter will take and how many pupils will master both objectives for the chapter. The first and most important goal is to get the multiplication facts mastered. Everything else rests on that achievement. The early use of a multiplication algorithm in easy problems should ensure success in handling partial products—the necessary skill before mastering multiplication of a 2-digit factor by a 1-digit factor.

The multiplication skills are slowly and sequentially developed. The sequence is exemplified below. The same single-digit factor is used here to keep the problems easy to inspect.

tens	ones
1	0
×	3
3	0

tens	ones
1	3
×	3
3	9

tens	ones
3	3
×	3
9	9

There is no renaming at first, but then—

h	t	o
	8	3
×		3
2	4	9

h	t	o	
	2	7	
×		3	
	2	1	(3 × 7)
	6	0	(3 × 20)
	8	1	

h	t	o	
	5	8	
×		3	
	2	4	(3 × 8)
1	5	0	(3 × 50)
1	7	4	

You can see that the successful use of an algorithm depends on the individual's knowledge of the multiplication facts and place value as well as addition skills.

Arrays are shown divided into parts to let the pupil see the distributive property of multiplication at work. The child is not expected to complete a sentence that illustrates the distributive property, such as $a \times (b + c) = (a \times b) + (a \times c)$. The property is not named or discussed even though the algorithm itself uses the basic idea.

Place-value heads continue to remind the pupil that although he is thinking a number fact, the product does have a place value. You also will see many little THINK reminders printed in color to help guide the pupil. The child should not be required to write these THINK steps when he computes on his own paper. It takes long enough to do a multiplication problem without all that extra writing.

It is unusual for multiplication to be featured this early in this level's work. The pupils need time to absorb the idea, and they need lots of practice. Starting early is one effective way of making sure that the pupils have time enough to gain computational skills in this area. It won't be so bad. And the pupils will feel so very grownup when they learn how to multiply.

things

index cards
rulers
overhead projector and transparencies with dot arrays (dots about 1 cm apart) or flannel board and felt pieces of 2 colors
graph paper

goal Think about and explore ideas through a picture clue

page 119 The youngsters would probably like to decide for themselves what objects are shown in the photograph. (They are pennants in a storage bin.) Then you can get to the vital question of *how many*.

Arrays will be used a lot in this chapter, and a quick reminder of carton packing is certainly appropriate. How many things have they seen packaged in cartons since the last time you talked about it? Has anyone decided why most things in a carton are put into rectangular boxes? Do they fit into cartons better? Is it easy to count how many there are in the carton if the objects are put in rows with the same number in each row? Does everyone remember how to count each row? count the number in each row? find out how many in all?

Put a 9-by-9 array on a transparency or on the chalkboard. Use two masks, one to cover some number of rows and the other to cover some number of objects in each row. As you adjust the masks to reveal various arrays, listen to how quickly you get answers to how many in all. Wouldn't it be great if everyone could quickly and confidently respond?

lesson Page 120

goal **Survey**—multiplying a 2-digit factor by a 1-digit factor

page 120 Have your pupils compute the answers to the questions on a piece of paper, then discuss their answers. Identify those who used repeated addition and those who used multiplication—your clue to pupils who may be able to move through the chapter at a faster pace. Remember to discuss the learning goal for the chapter.

You could have found
all the answers by adding.
Or you could have multiplied
Multiplication may be faster.
Your

GOAL

is to find answers
by multiplication.
Ready! Set! Go!

1. He loved candy. Do you?
   He wanted 2 bags of lemon candy.
   How much must he pay? 78¢

2. What kind of candy do you want?
   How much must you pay? Answers will vary.
   Example: Maple candy 45¢ for each bag

3. She bought 5 bags of fudge.
   How much did she pay? $3.00

4. Her friend bought 1 bag of lemon,
   1 of orange, and 1 of lime.
   How much did this cost? $1.17

5. The man bought 4 bags of mints.
   How much did he pay? $1.80

REMEMBER!

$$6 \times 3 = 18$$

Tells how many sets.
It is called a factor.

Tells how many in each set.
It is also called a factor.

Tells how many in all.
This is a product.

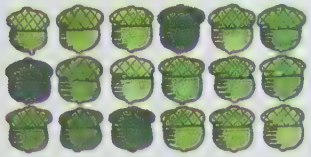
Symbol for *times*.
It signals
multiplication.

Symbol for *equals*.
What's on the left equals
what's on the right.

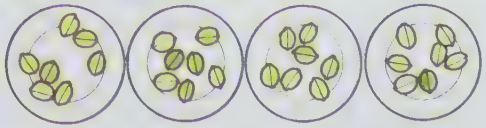
1. Answer each question.

a 5 rows of trees.
8 trees in each row.
How many trees in all? 40

b 3 rows of acorns.
6 acorns in each row.
How many acorns in all? 18



c 4 plates were there.
7 nuts on each plate.
How many nuts in all? 28



2. Go back. Name each factor. Tell which number is the product.

Factors:	Products:
a 8, 5	a 40
b 6, 3	b 18
c 7, 4	c 28

lesson Pages 121, 122, 123

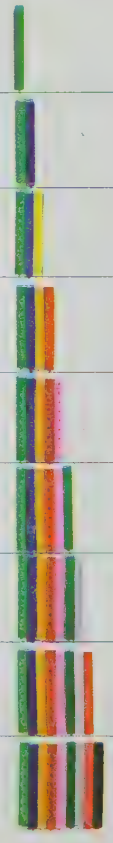
goal Review of the concept and terminology of multiplication

page 121 **Factor** and **product** are words that everyone will use every time multiplication is featured. And the array pops up again like an old friend. It is still appropriate to encourage the pupils to picture simple multiplication situations with an array. To check whether the pupils remember the array notion, ask them to draw an array for problem **1c.** Then question whether the picture that shows problem **1a** is easier to work with than is the picture for **1c.** Hope that most will pick the array as the easier.

Have pupils jot down answers. This page will identify pupils who have not remembered as much as is necessary to go into the chapter with confidence.

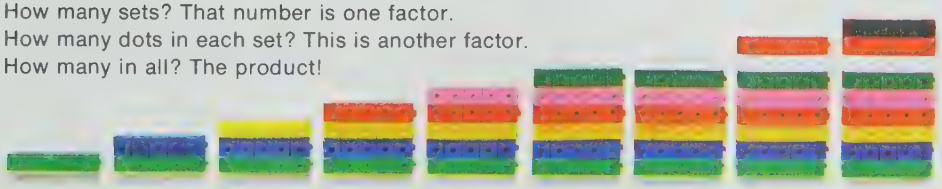
goal Review of and practice with the multiplication facts for 9

page 122 The focus is on products for 9. Discuss how an array can help in finding the unknown product. If skip-counting has proved helpful, practice with 9s now. Look for a pattern in the list of products. The more obvious pattern is this: As the ones digit goes down one, the tens digit goes up one. The less obvious pattern is this: Add the ones digit and the tens digit in each product; the sum is always 9.

	THE ARRAY	THE WORDS	THE FACTORS	THE PRODUCT	THE FACT
1.		1 set of 9	1 × 9	9	9 × 1 = 9
2.		2 sets of 9	2 × 9	18	9 × 2 = ■ 18
3.		3 sets of 9	3 × 9	■ 27	9 × 3 = ■ 27
4.		4 sets of 9	4 × 9	■ 36	9 × 4 = ■ 36
5.		5 sets of 9	5 × 9	■ 45	9 × 5 = ■ 45
6.		6 sets of 9	6 × 9	■ 54	9 × 6 = ■ 54
7.		7 sets of 9	7 × 9	■ 63	9 × 7 = ■ 63
8.		8 sets of 9	8 × 9	■ 72	9 × 8 = ■ 72
9.		9 sets of 9	9 × 9	■ 81	9 × 9 = ■ 81

122

1. How many sets? That number is one factor.
How many dots in each set? This is another factor.
How many in all? The product!



1 × 5	2 × 5	3 × 5	4 × 5	5 × 5	6 × 5	7 × 5	8 × 5	9 × 5
5 × 1 = ■ 5	5 × 2 = ■ 10	5 × 3 = ■ 15	5 × 4 = ■ 20	5 × 5 = ■ 25	5 × 6 = ■ 30	5 × 7 = ■ 35	5 × 8 = ■ 40	5 × 9 = ■ 45

2. The five-facts are easy to remember.
What about the six-facts? Draw an array if you need to.

6 × 1 = 6	6 × 2 = 12	6 × 3 = 18	6 × 4 = 24	6 × 5 = 30	6 × 6 = 36	6 × 7 = 42	6 × 8 = 48	6 × 9 = 54

3. Here are the seven-facts.

7 × 1 = 7	7 × 2 = 14	7 × 3 = 21	7 × 4 = 28	7 × 5 = 35	7 × 6 = 42	7 × 7 = 49	7 × 8 = 56	7 × 9 = 63

4. And here are the eight-facts.

8 × 1 = 8	8 × 2 = 16	8 × 3 = 24	8 × 4 = 32	8 × 5 = 40	8 × 6 = 48	8 × 7 = 56	8 × 8 = 64	8 × 9 = 72

goal Review of and practice with the multiplication facts for 5, 6, 7, and 8

page 123 Review the reading of arrays. You may wish to practice skip-counting as a group. Begin with counting by 3s, 4s, and 5s. Move on to counting by 6s. When these patterns seem fairly well mastered, go on to 7s, 8s, and 9s. It may be necessary to continue this practice for several days.

The objective is mastery of facts. Use the folded-paper method to record answers.

lesson Page 124

goal Examining multiplication facts on a number line

things index cards

page 124 The number line provides a contrast for arrays. Some pupils can successfully imagine a number line and will prefer thinking of a number line rather than of an array. That's O.K. The pupils should be free to use either model in order to achieve mastery of the multiplication facts.

Discuss how the number lines can help find the products. Practice with one or two examples.

Recording products for each row of facts should be independent work. Use the folded-paper method and have pupils record products only.

Have each pupil who makes errors using the number line and arrays prepare an error list or flash cards for the facts he missed. Encourage practicing with a buddy as well as getting help at home.

Some people use the number line to help them remember products. The distance each ⌒ covers is one factor. The number of ⌒ is the other factor.

1. 0 3 6 9 12 15 18 21 24 27

3 × 7 = 21	3 × 5 = 15	3 × 8 = 24	3 × 9 = 27	3 × 6 = 18

2. 0 4 8 12 16 20 24 28 32 36

4 × 6 = 24	4 × 8 = 32	4 × 5 = 20	4 × 7 = 28	4 × 9 = 36

3. 0 5 10 15 20 25 30 35 40 45

5 × 5 = 25	5 × 9 = 45	5 × 6 = 30	5 × 8 = 40	5 × 7 = 35

4. 0 6 12 18 24 30 36 42 48 54

6 × 8 = 48	6 × 5 = 30	6 × 9 = 54	6 × 6 = 36	6 × 7 = 42

5. 0 7 14 21 28 35 42 49 56 63

7 × 6 = 42	7 × 7 = 49	7 × 5 = 35	7 × 8 = 56	7 × 9 = 63

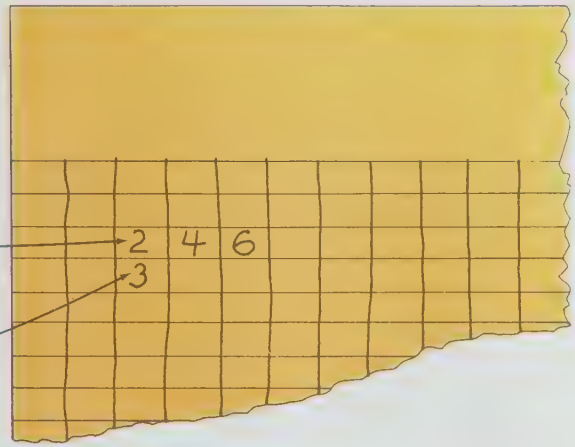
6. 0 8 16 24 32 40 48 56 64 72

8 × 7 = 56	8 × 9 = 72	8 × 8 = 64	8 × 5 = 40	8 × 6 = 48

7. 0 9 18 27 36 45 54 63 72 81

9 × 5 = 45	9 × 8 = 72	9 × 6 = 54	9 × 9 = 81	9 × 7 = 63

Get a clean sheet of paper.
Make sure it has lines marked on it.
Draw lines so that you have 11 columns.



1. If you draw lines about this far apart, you'll have space for all 11 columns.

2. Now in the third row in the third box, write 2. Start skip-counting. Count by 2s to 18. 2, 4, 6, 8, 10, 12, 14, 16, 18

3. Start the next row. Put 3 in the box right below the 2-box. Count by 3s to 27. 3, 6, 9, 12, 15, 18, 21, 24, 27

4. Keep on. Start another row. Count by 4s to 36. 4, 8, 12, 16, 20, 24, 28, 32, 36

5. Start with 5 in the next row. Count by 5s to 45. 5, 10, 15, 20, 25, 30, 35, 40, 45

6. On to the next row. Start with 6. Count by 6s to 54. 6, 12, 18, 24, 30, 36, 42, 48, 54

7. Start with 7 in the next row. Count by 7s to 63. 7, 14, 21, 28, 35, 42, 49, 56, 63

8. You're right if you guess the next row starts with 8. Count by 8s to 72. 8, 16, 24, 32, 40, 48, 56, 64, 72

9. And you have only one more row to do. Start with 9. Count by 9s to 81. 9, 18, 27, 36, 45, 54, 63, 72, 81

10. Read down the first column of numbers. What numbers do you read? 2 through 9 Are they in the same order as the numbers you wrote in the first row? No.

11. Read down the second column of numbers. Are these numbers in the same order as the numbers in the first row? 4, 6, 8, . . ., 18 Yes

lesson Pages 125, 126

goal Review of skip-counting to organize the multiplication facts

memo Pages 125 and 126 work together. Believe it or not, the good old-fashioned multiplication table will begin to evolve on page 125 and will be finished with the work on page 126. This activity may be a pain in the neck for you, but the pupils should gain an understanding of how all those numbers ended up in that table. Then everyone will be able to use the table more effectively.

things rulers

page 125 Directions for constructing a multiplication table are given on the page. You may choose to direct your pupils through each step or to use the page as an independent activity. The method you choose will depend upon the abilities of your pupils. A ruler will be helpful in making vertical lines. Why not let the activity provide practice in measuring too?

goal Completing the construction of a multiplication table; examining the table for information

memo This table should be saved and used for a personal reference. Make sure that the entries are correct!

things paper from page 125

page 126 Here are some more instructions for completing the table. Proceed as with page 125.

To summarize the activity, talk about how to read the table to find information.

1. Your paper shows all the products of the factors 2 through 9. You can't leave out the number 1, for goodness' sake! And if you have all the products, you must show the factors too.

X	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9
2	2	4	6	8	10	12	14	16	18
3	3	6	9	12	15	18	21	24	27
4	4	8	12	16	20	24	28	32	36
5	5	10	15	20	25	30	35		
6	6	12	18	24	30				
7	7	14	21	[illegible]					

← factors

← products of 1

a This column has products of 9.

b This column has products of 8.

c This column has products of 7.

d This column has products of 6.

e This column has products of 5.

f What products are shown in this column? Products of 4

g What products are shown in this column? Products of 3

h What products in this column? Products of 2

factors

products of 1

2. This is a very useful table. You can read it two ways. Products are shown in rows also.

a What products are shown in the row that starts with 3? Products of 3

b What products are shown in the row that starts with 4? Products of 4

c What products are shown in the row that starts with 6? Products of 6

d What products are shown in the row that starts with 9? Products of 9

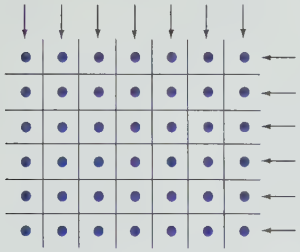
3. If you want to know the product of 7 and 3, read across to 7, then down to row 3.

X	1	2	3	4	5	6	7
1							
2							
3							21

And there is the product!

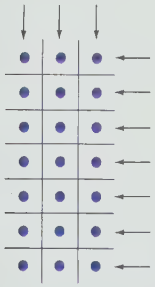
126

1. You can look at an array two ways.
This way you see 7 sets of 6. How many in all? 42



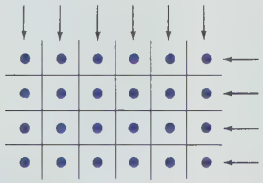
Look at it this way
and you can see
6 sets of 7 dots.
How many in all? 42

2. Look at this one this way.
You see 3 sets of 7 dots.



Look at it this way.
You see 7 sets
of 3 dots.
How many in all? 21

3. What do you see? 6 sets of 4 dots



What do you see? 4 sets of 6 dots
How many in all? 24

Multiply.

4.

6	5	7	5	8	5	9	5	6	7
× 5	× 6	× 5	× 7	× 5	× 8	× 5	× 9	× 7	× 6
30	30	35	35	40	40	45	45	42	42

5.

8	6	6	9	7	8	7	9	8	9
× 6	× 8	× 9	× 6	× 8	× 7	× 9	× 7	× 9	× 8
48	48	54	54	56	56	63	63	72	72

Maybe your job of learning the facts isn't so big after all.

lesson Pages 127, 128

goal Examining the order (commutative) property of multiplication

memo Pupils will discover that 6×7 and 7×6 have the same product. They should find out if that is true for other pairs of factors. The emphasis is on minimizing the number of facts to be mastered rather than on learning the technical name of a property. You may introduce the term **commutative** if you wish, but it will not be used on the pupil pages.

page 127 Discuss exercises 1, 2, and 3. You may want to try a few more examples than are provided by these problems. Does anyone need to construct arrays with counters? A 6-by-6 array presents an interesting challenge.

Use the folded-paper method for rows 4 and 5. Challenge pupils to find a pattern in the problems. Investigate to find out if the product for 5×6 also tells the product for another fact.

goal Completing the study of the multiplication table

page 128 The products of identical factors open the door to some interesting exploration:

- All these products fall on the diagonal of the multiplication chart.
- Make arrays with identical factors. Each array forms a square.
- Subtract pairs of these products. The difference is always an odd number.

You decide who is ready to tackle these ideas.

Problem 2 focuses on the commutative property. Each product indicated by a question mark or letter can be found in the top half of the chart by changing the order of the factors. For example, to find 6×4, look for 4×6.

Zero as a factor has been examined before. If someone has forgotten, review multiplication as repeated addition. 5×0 is the same as $0 + 0 + 0 + 0 + 0$. You may want to use the same technique with any pupils who have trouble with problem 4.

×	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									
5									
6									
7									
8									
9									

1. What products go where the boxes are?

1	2	3	4	5
× 1	× 2	× 3	× 4	× 5
1	4	9	16	25
6	7	8	9	0
× 6	× 7	× 8	× 9	× 0
36	49	64	81	0

×	1	2	3	4	5	6	7	8	9
1		2	3	4	5	6	7	8	9
2	?		6	8	10	12	14	16	18
3	?	?		12	15	18	21	24	27
4	?	a	?		20	24	28	32	36
5	?	?	b	?		30	35	40	45
6	?	c	?	d	?		42	48	54
7	?	?	e	?	f	?		56	63
8	?	?	?	?	?	g	h		72
9	?	?	?	i	?	j	?	k	

2. If you know the facts on half the table, do you know them all? Yes

   What product belongs where **a** is? 8
   What product goes in box **b**? 15
   in **c**? in **d**? in **e**? 12 24 21
   in **f**? in **g**? in **h**? 35 48 56
   in **i**? in **j**? in **k**? 36 54 72

3. Zero is not on the table. It could be.
   But you know the zero-facts, don't you? Prove it.

a	b	c	d	e	f	g	h	i
1	2	3	4	5	6	7	8	9
× 0	× 0	× 0	× 0	× 0	× 0	× 0	× 0	× 0
0	0	0	0	0	0	0	0	0

4. The one-facts are easy too.

1	4	6	3	8	5	2	9	7
× 1	× 1	× 1	× 1	× 1	× 1	× 1	× 1	× 1
1	4	6	3	8	5	2	9	7

Answer these.

1. 7 people.
   2 legs on each person.
   How many legs in all? 14

2. 9 stools.
   3 legs on each stool.
   How many legs in all? 27

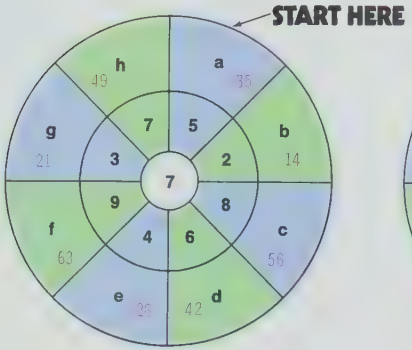
3. 8 horses.
   4 legs on each horse.
   How many legs in all? 32

4. 7 bugs.
   6 legs on each bug.
   How many legs in all? 42

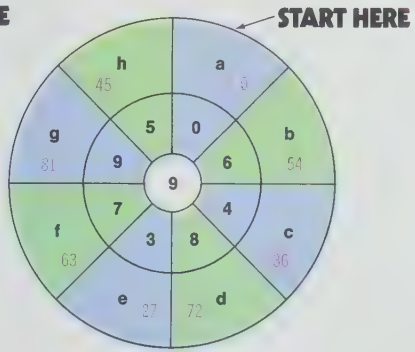
5. 5 tables.
   4 legs on each table.
   How many legs in all? 20

6. 6 spiders.
   8 legs on each spider.
   How many legs in all? 48

7. Multiply.



8. Multiply again.



9. 8 tricycles.
   3 wheels on each tricycle.
   How many wheels in all? 24

10. 6 planes.
    5 wheels on each plane.
    How many wheels in all? 30

11. 9 trucks.
    6 wheels on each truck.
    How many wheels in all? 54

12. 7 carts.
    4 wheels on each cart.
    How many wheels in all? 28

lesson Pages 129, 130

goal Application of and practice with the multiplication facts

page 129 The computation should be independent work. Does anyone need to draw pictures to interpret the problems?

For wheels 7 and 8, pupils need record only the letter and product (for example, **7a,** 35).

goal **Progress Check**—multiplication facts

page 130 This is a very demanding page. The emphasis is on accuracy. Use the folded-paper technique for recording products. You may choose to do sets I and II on one day, saving sets III and IV for another day. Another alternative is to have less confident pupils do sets I, II, and III—more confident pupils do sets II, III, and IV.

Once the facts that the learner has not yet mastered have been identified, **drill** is the word. Enlist the help of parents for those who need the most practice. Encourage study of that list of facts that each person needs to learn. Or would a flash card for each error provide more effective practice?

How many do YOU know?

SET I

	a	b	c	d
1.	1 × 2 = 2	2 × 3 = 6	5 × 2 = 10	4 × 3 = 12
2.	3 × 5 = 15	4 × 2 = 8	5 × 1 = 5	5 × 4 = 20
3.	3 × 3 = 9	2 × 2 = 4	5 × 5 = 25	4 × 4 = 16
4.	1 × 0 = 0	3 × 1 = 3	1 × 1 = 1	0 × 5 = 0

SET II

	a	b	c	d
1.	7 × 4 = 28	8 × 3 = 24	9 × 4 = 36	8 × 5 = 40
2.	8 × 4 = 32	7 × 5 = 35	9 × 3 = 27	8 × 2 = 16
3.	9 × 2 = 18	6 × 3 = 18	7 × 2 = 14	6 × 4 = 24
4.	9 × 5 = 45	6 × 5 = 30	7 × 3 = 21	6 × 2 = 12

Make a list of the facts that are hard. Work on them.

SET III

	a	b	c	d
1.	5 × 9 = 45	3 × 6 = 18	2 × 7 = 14	5 × 6 = 30
2.	2 × 9 = 18	3 × 7 = 21	4 × 6 = 24	2 × 6 = 12
3.	4 × 8 = 32	5 × 7 = 35	2 × 9 = 18	3 × 8 = 24
4.	3 × 9 = 27	4 × 7 = 28	4 × 9 = 36	5 × 8 = 40

SET IV

	a	b	c	d
1.	6 × 6 = 36	7 × 8 = 56	9 × 9 = 81	6 × 7 = 42
2.	9 × 7 = 63	7 × 6 = 42	8 × 7 = 56	6 × 8 = 48
3.	8 × 9 = 72	6 × 9 = 54	8 × 6 = 48	7 × 7 = 49
4.	9 × 6 = 54	8 × 8 = 64	7 × 9 = 63	9 × 8 = 72

130

See activity 1, page 144b.

See activity 2, page 144b.

How many in each row? 10
How many rows? 10

Count by 10s.
10, 20, 30, 40, 50, 60, 70, 80, 90, 100
How many sets of 10 did you count? 10

THINK	WRITE
1 × 1 ten = 1 ten	1 × 10 = 10
2 × 1 ten = 2 tens	2 × 10 = ■ 20
3 × 1 ten = 3 tens	3 × 10 = ■ 30
4 × 1 ten = ■ tens 4	4 × 10 = ■ 40
5 × 1 ten = ■ tens 5	5 × 10 = ■ 50
6 × 1 ten = ■ tens 6	6 × 10 = ■ 60
7 × 1 ten = ■ tens 7	7 × 10 = ■ 70
8 × 1 ten = ■ tens 8	8 × 10 = ■ 80
9 × 1 ten = ■ tens 9	9 × 10 = ■ 90

1. The multiplication could be written in this form too.

a

tens	ones
1	0
×	6
■	■

← 6 × 0 ones
← 6 × 1 ten
6 0

b

tens	ones
1	0
×	9
■	■

← 9 × 0 ones
← 9 × 1 ten
9 0

c

tens	ones
1	0
×	5
■	■

← 5 × 0 ones
← 5 × 1 ten
5 0

lesson Pages 131, 132, 133

goal Finding multiples of 10; readiness for the multiplication algorithm

memo The next several pages develop readiness for the multiplication algorithm. This is a time for a great deal of discussion in order to ensure success later.

page 131 Pupils should jot down answers to all questions before there is any talk. You may wish to let them use bundles of 10 sticks to reinforce counting by tens. The development of the multiplication algorithm starts at the bottom of the page.

The pupils' knowledge of multiplication facts now fits into a place-value context—ones times ones, then ones times tens. You will need to repeat this place-value pattern again and again. The placement of the digits in the correct place-value column will reinforce the pupils' knowledge of place value while they mentally operate only with the facts.

goal Developing the multiplication algorithm

memo Please notice that the arrays and the related expanded form are used only as thinking models. Stressing the written algorithm and its sequential steps will prevent many problems later when the child works with two 2-digit factors.

things overhead projector and transparencies with dot arrays (or flannel board and felt pieces of 2 colors)

page 132 Expand the models, using a visual device such as a projector or flannel board. Show the tens in one color, the ones in another. Pupils should see that the diagrams represent the place-value positions. Let them show some examples too.

Guide the youngsters through the thinking and writing steps. They need not write the thinking steps.

How many rows? How many in each row? 9 11

You can think of 11 as 10 + 1.

THINK 11 is 10 + 1

$$\begin{array}{r} 10+1 \\ \times \quad 9 \\ \hline 90+9 \end{array}$$

in all

BUT WRITE

$$\begin{array}{r|l} \text{tens} & \text{ones} \\ 1 & 1 \\ \times & 9 \\ \hline 9 & 9 \end{array}$$

9 × 1 one

9 × 1 ten

If your problem says 3 × 11,
THINK 11 is 10 + 1

$$\begin{array}{r} 10+1 \\ \times \quad 3 \\ \hline \blacksquare + \blacksquare \end{array}$$

30 3

BUT YOU WRITE

$$\begin{array}{r|l} \text{tens} & \text{ones} \\ 1 & 1 \\ \times & 3 \\ \hline \blacksquare & \blacksquare \end{array}$$

3 × 1 one

3 × 1 ten

3 3

1. Try these.

a

$$\begin{array}{r|l} \text{tens} & \text{ones} \\ 1 & 1 \\ \times & 5 \\ \hline \blacksquare & \blacksquare \end{array}$$

5 × 1 one

5 × 1 ten

5 5

b

$$\begin{array}{r|l} \text{tens} & \text{ones} \\ 1 & 1 \\ \times & 4 \\ \hline \blacksquare & \blacksquare \end{array}$$

4 × 1 one

4 × 1 ten

4 4

c

$$\begin{array}{r|l} \text{tens} & \text{ones} \\ 1 & 1 \\ \times & 6 \\ \hline \blacksquare & \blacksquare \end{array}$$

6 × 1 one

6 × 1 ten

6 6

What would happen if there were 13 in a row?
Then how many in 3 rows?

THINK 3 × 3 and 3 × 10

WRITE

tens	ones
1	3
×	3
3	9

3 × 3 ones

3 × 1 ten

1. Try these.

a

tens	ones
1	2
×	3
3	6

b

tens	ones
1	3
×	3
3	9

c

tens	ones
1	4
×	2
2	8

d

tens	ones
1	1
×	7
7	7

e

tens	ones
1	2
×	2
2	4

f

tens	ones
1	1
×	2
2	2

2.

a How many rows? 10

b How many in each row? 10

c How many in all? 100

goal Practice in multiplying a 2-digit factor (teen number) by a 1-digit factor

page 133 An example is provided for review. Watch for those pupils who are insecure. The youngsters must be working confidently here before going on.

lesson Pages 134, 135, 136

goal Extension of skill in multiplying a 2-digit factor by a 1-digit factor

page 134 The products expand to hundreds on this page. It's a time to talk together. The work presented here is similar to that covered on the previous pages and is preparation for individual work on the next two pages.

1. What would happen if the array had 4 rows BUT had 21 in each row?

tens | ones
2 1
× 4
■ ■ ← 4 × 1 one
4 × 2 tens
8 4

2. How many in 5 rows?

tens | ones
2 1
× 5
10 5 ← 5 × 1 one
5 × 2 tens

That's interesting! 5 × 2 tens is 10 tens. 10 tens is 100!

3. **WHAT'S NEXT?**

hundreds tens | ones
2 1
× 6
1 2 6 ← 6 × 1 one
6 × 2 tens

Remember—that's 12 tens or 120.

What do the letters stand for?
hundreds, tens, ones

4. h | t | o
2 1
× 9
■ ■ ■ ← 9 × 1 ones
9 × 2 tens
1 8 9

5. h | t | o
2 0
× 7
■ ■ ■ ← 7 × 0 ones
7 × 2 tens
1 4 0

6. h | t | o
9 3
× 2
■ ■ ■ ← 2 × 3 ones
2 × 9 tens
1 8 6

7. h | t | o
3 0
× 5
■ ■ ■ ← 5 × 0 ones
5 × 3 tens
1 5 0

8. h | t | o
4 3
× 3
■ ■ ■ ← 3 × 3 ones
3 × 4 tens
1 2 9

9. h | t | o
7 2
× 4
■ ■ ■ ← 4 × 2 ones
4 × 7 tens
2 8 8

10. h | t | o
6 1
× 8
■ ■ ■ ← 8 × 1 ones
8 × 6 tens
4 8 8

134

1. h t o
   2 1
   × 7
   1 4 7 ← 7 × 1 one
   ↳ 7 × 2 tens

2. h t o
   3 2
   × 4
   ■■■ ← 4 × 2 ones
   ↳ 4 × 3 tens
   1 2 8

3. h t o
   3 1
   × 6
   ■■■ ← 6 × 1 one
   ↳ 6 × 3 tens
   1 8 6

TRY THESE.

4. h t o
   5 3
   × 3
   1 5 9

5. h t o
   4 0
   × 6
   2 4 0

6. h t o
   8 4
   × 2
   1 6 8

7. h t o
   5 1
   × 5
   2 5 5

8. h t o
   7 1
   × 6
   4 2 6

9. h t o
   4 0
   × 9
   3 6 0

10. h t o
    3 0
    × 8
    2 4 0

11. h t o
    4 2
    × 3
    1 2 6

12. h t o
    6 1
    × 6
    3 6 6

13. h t o
    7 3
    × 2
    1 4 6

14. h t o
    5 0
    × 7
    3 5 0

15. h t o
    8 2
    × 4
    3 2 8

Now you are really making progress.

16. h t o
    4 1
    × 4
    1 6 4

17. h t o
    7 3
    × 3
    2 1 9

18. h t o
    9 2
    × 3
    2 7 6

19. h t o
    5 1
    × 2
    1 0 2

goal Practice in multiplying a 2-digit factor by a 1-digit factor with no renaming

page 135 Use this page for independent practice. Lined paper turned sideways will provide the learner with columns for place value.

goal **Progress Check**—multiplying a 2-digit factor by a 1-digit factor

page 136 Use problems 1, 2, and 3 for a review. Notice that the place-value heads and the rules separating the digits are phased out.

Problems 4 through 15 are a Progress Check that will help you identify pupils who need additional help. If the problem is one of multiplying tens, check to see whether the pupil knows the basic facts involved. Does he place his answer correctly?

Have fun with the multiplication wheels in problem 16. Challenge youngsters to make up other wheels.

1.
```
   h | t | o
     | 7 | 1
×    |   | 5
-----------
   3 | 5 | 5
```

2.
```
     | 8 | 3
×    |   | 3
-----------
   2 | 4 | 9
```

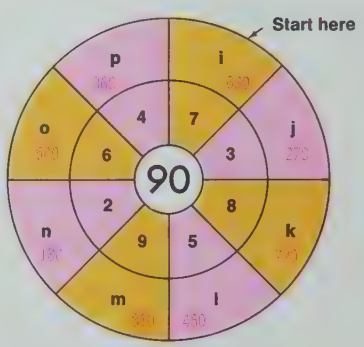
3.
```
   32
×   4
-----
  128
```

If the lines that separate the value of the numbers help you, please put them in for yourself when you do your work on your paper.

4. 40 × 8 = 320 **5.** 31 × 7 = 217 **6.** 72 × 4 = 288 **7.** 50 × 6 = 300 **8.** 92 × 3 = 276 **9.** 60 × 4 = 240

10. 81 × 5 = 405 **11.** 41 × 6 = 246 **12.** 60 × 5 = 300 **13.** 51 × 7 = 357 **14.** 92 × 2 = 184 **15.** 81 × 6 = 486

16. Complete the multiplication wheels.



136

See activity 3, page 144b.

See activity 4, page 144b.

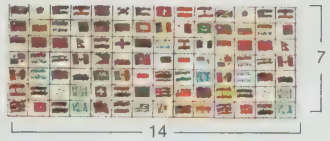
TALK ABOUT THIS PAGE

A picture sometimes helps you think through a problem.
An array really helps on this page.

Here's a special kind of problem.

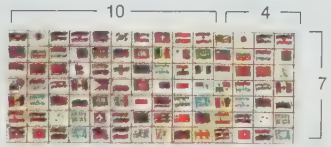
7×14

And here's the array that shows it.



You know how to multiply ones.
You know how to multiply tens.
So this can't be so hard.

Think about the array this way.
It still shows 7 rows and
4 + 10 in each row.



Do you suppose we could multiply
7×4 and 7×10 and get the answer?
Yes – by adding the two products

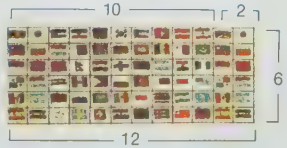
Try it!

$7 \times 14 = \underline{?}$

	tens	ones	
	1	4	Is 1 ten + 4 ones another name for 14?
×		7	
	2	8	7×4
	7	0	7×10
98	■	■	Add to find how many in all.

$6 \times 12 = \underline{?}$

	1	2	
×		6	
12	■	■	6×2
60	■	■	6×10
72	■	■	Add to find how many in all.



lesson Pages 137, 138, 139, 140, 141

goal Introduction to multiplying a 2-digit factor by a 1-digit factor with renaming

memo Pages 137 and 138 are the most important pages in the entire chapter. In fact, the learning on these pages will determine the pupils' understanding and future success with the entire operation of **long** multiplication. Go slow and easy on these pages. Though the problems appear similar to the ones covered on previous pages, renaming is now necessary.

things graph paper
flannel board
felt pieces

page 137 Renaming is handled by using partial products. Draw attention to the grouping of the arrays to represent the place values of the numbers. Extend work with arrays on the flannel board or graph paper. Manipulating arrays is invaluable at this point if the pupils are to understand the origin and significance of partial products.

goal Practice in multiplying a 2-digit factor by a 1-digit factor with renaming

page 138 Only those youngsters who feel comfortable with the two partial products should go on independently. Otherwise, guide their thinking as they record the partial products and add to find the total product.

You can get some "thinking" help without an array, too.

THE PROBLEM $6 \times 13 = \underline{?}$

THINK

13 is 10 + 3

$\times$ 6

60 + 18 or 78 in all

WRITE

tens	ones	
1	3	
×	6	
1	8	6 × 3
6	0	6 × 10
7	8	in all

TRY THESE

a

tens	ones
1	7
×	5
3	5
5	0
8	5

b

tens	ones
1	6
×	4
2	4
4	0
6	4

c

tens	ones
1	3
×	5
1	5
5	0
6	5

d

tens	ones
1	2
×	6
1	2
6	0
7	2

e

tens	ones
1	4
×	4
1	6
4	0
5	6

f

tens	ones
1	9
×	5
4	5
5	0
9	5

g

tens	ones
1	5
×	6
3	0
6	0
9	0

h

tens	ones
1	4
×	3
1	2
3	0
4	2

i

tens	ones
1	5
×	4
2	0
4	0
6	0

j

tens	ones
1	2
×	5
1	0
5	0
6	0

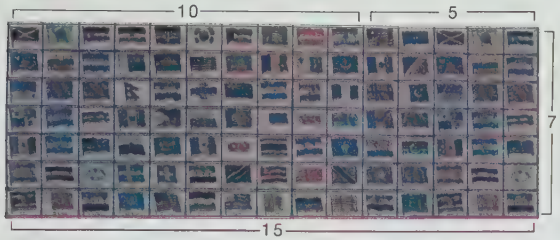
k

tens	ones
1	8
×	5
4	0
5	0
9	0

l

tens	ones
1	6
×	5
3	0
5	0
8	0

$7 \times 15 = \underline{?}$ You could use the array



You could think

$$\begin{array}{r} 10 + 5 \\ \times \quad 7 \\ \hline ? + ? \end{array}$$

But you compute →

tens	ones	
1	5	
×	7	
3	5	7×5
7	0	7×10
1 0	5	in all

We need the hundreds place again!

YOUR TURN

Copy these on your paper.

1.

h	t	o
	1	7
×		5
	3	5
	5	0
	8	5

2.

h	t	o
	1	6
×		8
	4	8
	8	0
1	2	8

3.

h	t	o
	1	8
×		9
	7	2
	9	0
1	6	2

4.

h	t	o
	1	3
×		7
	2	1
	7	0
	9	1

5.

h	t	o
	1	9
×		4
	3	6
	4	0
	7	6

6.

h	t	o
	1	7
×		7
	4	9
	7	0
1	1	9

7.

h	t	o
	1	9
×		6
	5	4
	6	0
1	1	4

8.

h	t	o
	1	6
×		5
	3	0
	5	0
	8	0

9.

h	t	o
	1	4
×		9
	3	6
	9	0
1	2	6

goal Practice in multiplying a 2-digit factor by a 1-digit factor with renaming

page 139 These problems should not be much more difficult than previous problems. Some products will contain a hundreds digit.

Problems 1 through 9 are independent work. Watch for insecure pupils, and give them help now. It will save remediation work later. Use peer tutors if possible and practical.

goal **Progress Check**—multiplying a 2-digit factor by a 1-digit factor with renaming

page 140 Have the youngsters check problems 1 and 2. Any problems? Then have them go on to problems 3 through 12.

Look for youngsters who multiply correctly but make addition errors.

```
  25
×  7
  35
 140
 185
```

And watch for those with place-value problems.

```
  25                    25
×  7                  × 7
  35    7 × 2  = 14     35
 (14)   7 × 20 = 140   140
  49                   1435
```

140 placed incorrectly.

Lined paper turned sideways will help keep columns aligned. Use these problems as a Progress Check.

Pupils who perform satisfactorily can proceed to page 141 and work independently.

Practice some more.

1.

```
  19
×  6
  54   6 × 9
  60   6 × 10
 114   in all
```

This next one looks different, but it is computed in the same way.

2.

```
  24
×  6
  24   6 × 4
 120   6 × 20
 144   in all
```

3. 25 × 7 = 35, 140, 175

4. 25 × 8 = 40, 160, 200

5. 34 × 6 = 24, 180, 204

6. 37 × 4 = 28, 120, 148

7. 53 × 5 = 15, 250, 265

If the clues help, you can put them in.

8. 43 × 8 = 24, 320, 344

9. 45 × 5 = 25, 200, 225

10. 68 × 4 = 32, 240, 272

11. 74 × 5 = 20, 350, 370

12. 27 × 6 = 42, 120, 162

Now you're really on your own.

13. 49 × 5 = 45, 200, 245

14. 68 × 2 = 16, 120, 136

15. 27 × 4 = 28, 80, 108

16. 64 × 6 = 24, 360, [illegible]

17. 73 × 7 = 21, 490, 511

18. 82 × 9 = 18, 720, 738

See activity 5, page 144b.

See activity 3, page 72a.

Variations:
1. Change to subtraction.
2. Prepare a game board for multiplication.

Dan worked in a candle store. Candles were the only thing they sold. But there were many different kinds. There was no adding machine. If someone bought more than one candle, Dan would have to compute the cost. Dan was smart. He knew when he was busy he didn't have time to check his arithmetic. So he decided to make charts for himself. He got them started. Put them on your paper and finish them.

Style A
55¢ each

1	2	3	4	5	6	7	8	9
55¢	$1.10	a	b	c	d	e	f	g
		$1.65	$2.20	$2.75	$3.30	$3.85	$4.40	$4.95

Style B
19¢ each

1	2	3	4	5	6	7	8	9
19¢	38¢	a	b	c	d	e	f	g
		57¢	76¢	95¢	$1.14	$1.33	$1.52	$1.71

Style C
78¢ each

1	2	3	4	5	6	
78¢	$1.56	a	b	c	d	No one had ever bought more than 6.
		$2.34	$3.12	$3.90	$4.68	

Style D
9¢ each

1	2	3	4	5	6	7	8	9	10
9¢	18¢	a	b	c	d	e	f	g	h
		27¢	36¢	45¢	54¢	63¢	72¢	81¢	90¢

goal Application of multiplication

page 141 Use this page for independent learners while you work with pupils who still need guidance.

lesson Pages 142, 143

goal Exploring multiplication of a 2-digit factor by 10

memo Pages 142 and 143 are extension pages. They provide the pupil with a taste of what is to come. Mastery is not the objective—exploration is.

page 142 Capable students can investigate independently. If reading is a problem for others, discuss the page together. Don't tell—let them discover the shortcut.

Dan didn't worry when someone bought the 10-cent candles.
He had a quick way to multiply. He didn't even write the problem down on paper.
He knew his answer would be right. Try to figure out his shortcut.

	a	b	c	d	e	f	g	h
1.	10 × 2 = 20	10 × 3 = 30	10 × 4 = 40	10 × 5 = 50	10 × 6 = 60	10 × 7 = 70	10 × 8 = 80	10 × 9 = 90
2.	10 × 10 = 100	10 × 11 = 110	10 × 12 = 120	10 × 13 = 130	10 × 14 = 140			

Have you found the shortcut yet?
Put a 0 after the number of candles purchased.

If not, try some more. Change the order of factors.
Maybe the shortcut will be easier to discover.

	a	b	c	d	e	f	g	h
3.	18 × 10 = 180	19 × 10 = 190	20 × 10 = 200	22 × 10 = 220	28 × 10 = 280	35 × 10 = 350	46 × 10 = 460	59 × 10 = 590

×	10	20	30	40	50	60	70	80	90
1	10	20	30	40	50	60	70	80	90
2	20	40	60	80	1[illegible]				
3	30	60	90						
4	40	80							
5	50								
6	60								
7	70								
8	80								
9	90								

What would happen if you were working
with 2 tens (20) or
3 tens (30) or
6 tens (60)?

Find out

Finish a chart like this on your paper.
It isn't hard.
It might end up looking a lot like another chart you made.
It would look like the chart of multiplication facts with a 0 annexed to the factors across the top and to each product.

142

1. They rode to the airport on a shuttle bus. The bus had 10 rows of seats. There were 4 seats in each row. How many seats in all? 40

2. There were 5 of them. The bus fare was 20 cents. How much did they pay in all for bus fare? $1.00 or 100¢

3. They waited for the elevator to the observation deck. The elevator held 20 people. A lot of people waited. The elevator loaded 3 times before they got on. How many people got to the deck before they did? 60

4. They got to go inside a plane. They counted 20 rows of 6 seats. How many people could be seated in this plane? 120

5. They stopped for a milk shake. Each one of them had one. Each shake cost 30¢, including tax. How much did all of the milk shakes cost? $1.50 or 150¢

6. They went home on the bus. It cost 20¢ apiece again.

   a How much did each one of them spend from the time they got on the bus to go until they got home? 70¢

   b What was the total amount that all five spent? $3.50 or 350¢

goal Application of multiplication

page 143 These problems are not easy. You decide how best to use the page with your various ability groups. It can be used as independent work for capable students or as a group project. Help with reading, if necessary.

lesson Page 144

goal **Checkout**—multiplication skills (identified on answer key)

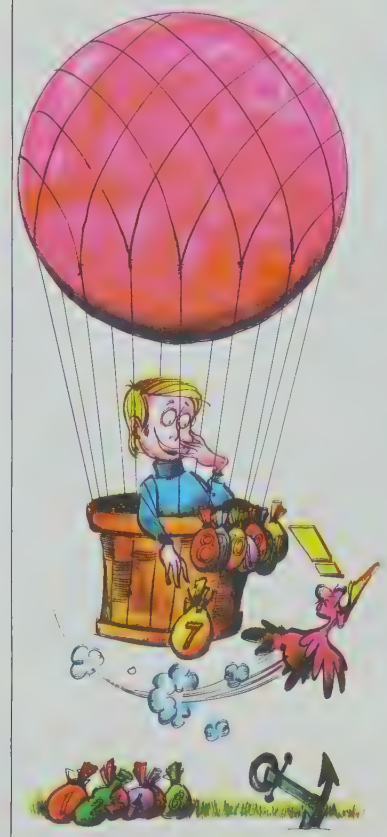
page 144 Everyone is on his own. If your pupils are immature, you may wish to take two days to finish the page. Assign exercise 1 on the first day, the remainder of the page on the second day.

Check those errors. Identify the causes of trouble:

- Basic facts? Check both addition and multiplication facts. Use peer tutors if more practice is needed.
- Aligning place-value columns? Go back to turning lined paper sideways and writing in the headings.
- Multiplying tens? This one will need your attention.

Be gentle, but make your pupils aware of their consistent errors.

CHECKOUT



1. Make a chart like this one and complete it. Skill: Multiplication facts, multiplying a 2-digit multiple of 10

If a box contains	2	3	4	5	6	7	8
a How many in 2 boxes?	? 4	? 6	? 8	?10	?12	?14	?16
b in 5 boxes?	?10	?15	?20	?25	?30	?35	?40
c in 9 boxes?	?18	?27	?36	?45	?54	?63	?72
d in 10 boxes?	?20	?30	?40	?50	?60	?70	?80
e in 12 boxes?	?24	?36	?48	?60	?72	?84	?96
f in 20 boxes?	?40	?60	?80	? 100	? 120	? 140	? 160

2. Remember the symbols >, <, =?

   > means "is more than" < means "is less than"
   = means "is the same as"

   Tell which of the signs should be in place of the ? to make each sentence true.
   Skill: 1-digit factor times 2-digit factor, with renaming

   a 8×12 ? 3×28 (>) b 38×4 ? 8×19 (=)
   c 5×42 ? 6×35 (=) d 58×9 ? 9×61 (<)
   e 9×89 ? 8×92 (>) f 76×5 ? 8×37 (>)

3. You have worked very hard. Did you make progress? Do these problems to prove it. You start with—
   Skills: Basic facts, no renaming, with renaming

   8×7 = ? (56) then to 10×3 = ? (30) then to 12×4 = ? (48) then to 14×6 = ? (84) then to 25×8 = ? (200) and then 67×5 = ? (335)

You have done a good job. Thank you for trying so hard.

144

See activity 6, page 144c.

See activity 7, page 144c.

RESOURCES

another form of evaluation

for Progress Check—page 130
How many multiplication facts do you know?

Set 1

	(a)	(b)	(c)	(d)
1.	3 × 2 = 6	5 × 3 = 15	2 × 5 = 10	1 × 4 = 4
2.	2 × 1 = 2	3 × 4 = 12	2 × 2 = 4	4 × 5 = 20
3.	3 × 3 = 9	3 × 5 = 15	2 × 4 = 8	0 × 2 = 0
4.	5 × 4 = 20	4 × 4 = 16	3 × 0 = 0	5 × 5 = 25

Set 2

	(a)	(b)	(c)	(d)
1.	9 × 3 = 27	6 × 4 = 24	7 × 5 = 35	8 × 2 = 16
2.	8 × 4 = 32	7 × 2 = 14	6 × 3 = 18	9 × 5 = 45
3.	7 × 3 = 21	8 × 5 = 40	9 × 2 = 18	7 × 4 = 28
4.	8 × 1 = 8	9 × 4 = 36	6 × 5 = 30	8 × 3 = 24

Set 3

	(a)	(b)	(c)	(d)
1.	3 × 7 = 21	2 × 6 = 12	5 × 9 = 45	4 × 8 = 32
2.	2 × 8 = 16	5 × 7 = 35	4 × 6 = 24	3 × 9 = 27
3.	3 × 6 = 18	2 × 9 = 18	5 × 8 = 40	4 × 7 = 28
4.	4 × 9 = 36	2 × 7 = 14	5 × 6 = 30	3 × 8 = 24

Set 4

	(a)	(b)	(c)	(d)
1.	7 × 7 = 49	8 × 6 = 48	6 × 9 = 54	9 × 8 = 72
2.	8 × 7 = 56	9 × 9 = 81	6 × 8 = 48	7 × 9 = 63
3.	9 × 7 = 63	7 × 6 = 42	8 × 8 = 64	6 × 7 = 42
4.	8 × 9 = 72	9 × 6 = 54	7 × 8 = 56	6 × 6 = 36

for Progress Check—page 136

1. 30 × 5 = 150	2. 53 × 3 = 159	3. 21 × 8 = 168	4. 42 × 3 = 126
5. 61 × 7 = 427	6. 62 × 4 = 248	7. 20 × 6 = 120	8. 71 × 2 = 142
9. 52 × 4 = 208	10. 70 × 3 = 210	11. 91 × 6 = 546	12. 90 × 4 = 360

for Progress Check—page 140

13. 56 × 4 = 24 + 200 = 224	14. 48 × 3 = 24 + 120 = 144	15. 39 × 7 = 63 + 210 = 273
16. 83 × 6 = 18 + 480 = 498	17. 92 × 5 = 10 + 450 = 460	18. 75 × 8 = 40 + 560 = 600

for Checkout—page 144

1. Complete.

If the bag contains	2	3	4	5	6	7	8
a) How many in 3 bags?	6	9	12	15	18	21	24
b) in 6 bags?	12	18	24	30	36	42	48
c) in 8 bags?	16	24	32	40	48	56	64
d) in 10 bags?	20	30	40	50	60	70	80
e) in 12 bags?	24	36	48	60	72	84	96
f) in 50 bags?	100	150	200	250	300	350	400

2. Remember the symbols >, <, and = ?
> means "is greater than"; < means "is less than"; = means "is the same as." Tell which sign would make each sentence true.

a) 6×17 ? 4×28 (<)
b) 46×2 ? 4×23 (=)
c) 5×23 ? 2×56 (>)
d) 12×7 ? 3×25 (>)
e) 7×16 ? 3×26 (>)
f) 57×3 ? 5×37 (<)

3. You've done a lot of hard work. Did you make progress? Do these problems to prove it. You started with—

6	then	30	then	23	then
×9	to	× 2	to	× 2	to
54		60		46	
15	then	34	and	76	
× 7	to	× 4	then	× 8	
105		136		608	

Wow! That was a big job. Thank you for trying so hard.

activities

1. things multiplication fact cards (no answers visible), small box, markers

Have pupils fold a piece of paper into 16 spaces to form a 4-by-4 grid, select 16 products from the multiplication chart (page 126), and write one product in each space. The cards are mixed in the small box.

One pupil serves as caller, drawing a fact card from the box and reading it. If the product appears on their sheet, the players cover it with some sort of marker. A row across, a column down, or a diagonal covered wins the game. Drawn cards are not returned to the box; they can be used to verify covered answers in case of a dispute.

2. things 4 sets of numeral cards 0 through 9

Form groups of 2, 3, or 4 players. Shuffle the cards and deal all of them facedown. The cards remain facedown in a stack before each player. In each round, each player turns over the 2 top cards in his stack and names the product. The player with the greatest product wins and takes all the faceup cards. If there is a tie for the greatest product, all the cards remain and only those players who tied play another round. The winner of this round collects all the faceup cards.

Products can be challenged. If the challenged player did name an incorrect product, his 2 cards go to the challenger. If the product is correct, however, the challenger gives his cards to the player he challenged.

3. things game board; 25 small cards

Prepare a game board as shown. Write the factors in order to simplify locating the numbers.

X	30	50	60	80	90
2					
5					
6					
7					
8					

Write one of the products on each small card. These cards (tiles) should be the same size as the empty boxes on the game board.

Turn the answer tiles facedown in random order. Each player selects 4 tiles. The first player places an answer tile in any box for which the numeral on the tile is the product. Each succeeding player then attempts to place a tile on the board so that it is a correct product and touches (vertically or horizontally) a tile played previously by another player. If a player does not have a tile he can play, he draws from the facedown tiles until he finds one he can use. The winner is the first player to use all his tiles.

4. Independent activity (Provide the pupil with the following directions.)

1. Write a 1-digit numeral.
2. Double it.
3. If the product is a 1-digit number, repeat step 2. Otherwise proceed to step 4.
4. Reverse the digits in the 2-digit number.
5. Add these 2-digit numbers.
6. Is there anything **special** about the sum for step 5? Will the same thing happen if you begin with a different 1-digit number? Try it.

5. things spirit master

When preparing the spirit master, leave some grids without factors. Have the youngsters choose their own numbers and write them in.

X	35	74	
6			___
9			+
___ + ___			

X	35	74	
6	210	444	654
9	315	666	+981
525 +	1110		1635

These grids are completed by writing the products in the empty boxes—as in work with the multiplication chart.

To check the results, the pupil adds the two **products** in each row and in each column, writing the sums on the appropriate lines. The sums are then added vertically and horizontally. This sum should be the same in both directions and is written in the box.

6. things index cards

Write a set of problems on one side of the card. Cut out slits where the answers are usually written. Turn the card over and write the correct answers above the slits. Careful to keep the problems in the proper sequence!

Front

7	8	9	6
× 9	× 4	× 4	× 7
32	33	21	24
× 4	× 3	× 4	× 2

Back

63	32	36	42
Answers			
128	99	84	48
Answers			

The pupil places his paper under the problem card and records only the products. When he finishes, he turns the card over and places it on top of his paper so that his answers show through the slit. He can check his answers with those on the card.

Group the problems on a card by a specific skill to be practiced, thus providing individualized practice.

7. Look for a pattern. Check each row and each column. Then fill in the empty boxes.

4	8	12		
5	8	11		
6	8	10		

4	16	8
6		12
8	32	
	40	20
12		

additional learning aids

operation—chapter objectives 1, 2

SRA products

Arithmetic Fact Kit, SRA (1969)
Multiplication cards: 2–24
Computapes, SRA (1972)
Module 3, Lessons: MD 3, 4, 5, 9
Cross-Number Puzzles (Whole Numbers), SRA (1966)
Multiplication cards: 1, 2, 3, 4
diagnosis: an instructional aid—Mathematics Level A, SRA (1973)
Probe: L-3
Mathematics Involvement Program, SRA (1971)
Cards: 24, 64
Skill through Patterns, level 3, SRA (1974)
Spirit masters: 34, 36, 37, 38, 39, 41, 42, 43
Visual Approach to Mathematics, level 3, SRA (1967)
Visuals 15, 16, 17, 18

other learning aids (described on page 144i)—I Win (sets 2 and 3), Mathfacts Game (level 3), Multifax & Quotient, Multiplying Machine, Orbiting the Earth (multiplication), Veri-Tech Senior (addition, subtraction, and multiplication books), Quizmo (multiply-divide)

Greatest Product

Four people play the game with 32 cards.

Deal eight cards facedown to each player. Dealer plays a card faceup on the table. The next player plays a card with a greater product. Then the next player plays a product greater than the last, and so on.

When a player has no greater product, he says "pass" and is out for the round. Play continues until no player can play a greater product. The player of the last card (the greatest product on the table) picks up all the cards and begins a new round. Everyone plays again.

The person who gets all 32 cards wins the game.

14 × 6	27 × 3	38 × 2	11 × 9	62 × 8	35 × 4	49 × 8	53 × 7
69 × 2	78 × 4	34 × 5	25 × 6	16 × 7	21 × 8	31 × 7	42 × 6
47 × 9	57 × 8	50 × 4	63 × 7	65 × 2	74 × 2	79 × 5	82 × 6
88 × 5	86 × 3	91 × 8	95 × 3	98 × 6	90 × 9	17 × 5	63 × 7

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Mini-flashcards • Use for subtraction or multiplication.

18 9	17 9	17 8	16 9	16 8	16 7	15 9	15 8	15 7
15 6	14 9	14 8	14 7	14 6	13 9	13 8	13 7	13 6
13 5	13 4	12 9	12 8	12 7	12 6	12 5	12 4	12 3
11 9	11 8	11 7	11 6	11 5	11 4	11 3	11 2	11 1

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Mini-flashcards • Use for subtraction or multiplication.

9 9	9 8	9 7	9 6	9 5	9 4	9 3	8 7	8 6
8 5	8 4	8 3	8 2	7 6	7 5	7 4	7 3	7 2
6 5	6 4	6 3	6 2	5 4	5 3	5 2	4 3	4 2
3 2	0 0	1 1	9 0	8 1	7 0	6 1	5 0	2 1

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name_____

is trapped in a Mad Math Maze. Help him get out. Start on 1 and move to square 2. You can move or or or or or or or . Move one square at a time. Move from 1 to 2 to 3 to 4. Move in order to 36. Show how to get free. Don't forget to go through every number from 1 to 36.

26	5	4	17	26	7	24	17	23
6	27	3	27	6	25	4	23	22
30	7	28	2	2	3	5	6	21
29	8	29	2	1	4	7	8	20
16	30	3	13	2	3	8	9	19
17	31	4	12	11	9	11	10	18
18	32	14	5	12	10	12	17	12
19	13	33	6	13	14	13	16	26
20	12	7	34	16	15	14	15	17
11	21	8	9	35	16	17	16	18
10	9	11	10	36	19	18	19	29

is free!

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THIS CERTIFIES THAT

_____

IS A

SUBTRACTION SUPERSTAR

DATE _____ CERTIFIED BY _____

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Other Learning Aids

whole-number concepts

Abacus board (Creative Publications) Counting board useful for teaching place value
Abacus Spinner Game (Math Shop) Game for recognition and understanding of place value
Chip Trading (Scott Scientific) Several games that develop understanding of place value
Flip-A-Strip Place Value Chart (Developmental Learning Materials) Easel board chart to provide practice with place value and whole-number operations
Place Value I and II (Math Shop) Self-correcting cards to provide practice in reading of numbers through hundred millions

whole-number operations

Calculator (Sigma Scientific) Four place-value calculator for addition and subtraction
Checkermatics (SEE) [level 1] A game for reinforcement and enrichment in whole-number skills
Counting chips (Creative Publications) Plastic disks of eight colors
Cuisenaire Rods® (Cuisenaire) Centimetre rods that provide a concrete approach to developing operations
Dividing Machine (DLM) Device to reinforce basic division facts
Fact-O (Math Shop) Activities for addition and subtraction facts
I Win (Scott, Foresman) [sets 1 and 2] Cards to provide practice in four basic operations
Lots-A-Links (Creative Publications) Plastic links that snap together for counting activities
Mathematical Balance (Mind/Matter) Plastic balance and weights to show relationships between addition and subtraction
Mathfacts Games™ (Milton Bradley) [levels 3–5] Self-instructional and self-checking games that deal with the basic facts
Multifax & Quotient (Math Shop) Games in which number sentences are formed
Multiplying Machine (Math Shop) Self-checking machine used to practice the facts
Orbiting the Earth (Scott, Foresman) [addition and subtraction] Game with vinyl playing field for fact practice
Quizmo (Milton Bradley) Lotto-type game that reinforces basic skills with whole numbers
Stamina (Creative Publications) Spinner game providing practice with whole-number operations
Tally and Difference (Creative Publications) Games in which the addition and subtraction facts are used to form number sentences
Unifix Mathematics Classroom Kit (ETA) Set of interlocking cubes that develop understanding of the whole-number operations
Veri-Tech Senior (ETA) [addition, subtraction, and multiplication books] A self-checking device that provides practice with whole-number operations
Winning Touch (Ideal) A game for multiplication facts

fractional-number concepts

Action Fraction Games (Constructive Playthings) Games to develop concepts and skill with fractions
Fraction Bars Student Activity Book (Creative Publications) Games and activities to teach specific objectives for fractions
Fraction Dominoes (SEE) Game involving matching a fractional numeral with its model
Fraction Inlay Boards (General Learning Corp.) Fractional parts of circles or squares
Fraction Line Set (Sigma Scientific) An activity to help visualize operations by computing with fraction strips

geometry

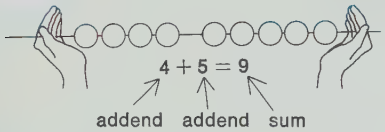
Geoboard Activity Cards (Creative Publications) [primary and intermediate sets] Geoboard activities that lead pupils to explore, compare, and make shapes
Geoboard Kit (Cuisenaire) Plastic geoboards and related activity cards that show basic geometric concepts
Learn to Fold—Fold to Learn (Lyons & Carnahan) Workbook that presents a variety of activities to demonstrate symmetry
Metric Primary Shapes (Invicta) Basic geometric shapes and work cards that reinforce identification skills
Mira (Creative Publications) An aid for investigating properties of plane geometry
Mira Math for Elementary School (Creative Publications) Series of activities to be used with the mira
Paper and Pencil Geometry (Lyons & Carnahan) A geometry book that provides activities to develop basic geometric concepts
Pattern Blocks and Mirrors (Math Shop) Colored blocks used to investigate geometric figures and mirror reflections
Tangrams (Creative Publications) A 7-piece puzzle to be used with tangram shapes
Tangramath (Creative Publications) Book to be used with tangram pieces for exploring concepts of shape, congruence, similarity, and area

measurement

Equal Pan Scales (ESA) Pan balance designed to develop weighing techniques
Judy Clock (General Learning) Movable hands and visible functioning gears to provide learning experiences in telling time
Learning about Measurement (Lyons & Carnahan) A workbook for customary and metric measurement activities
Linear Measures (DLM) A series of linear measuring activities using the customary system
Making and Using Graphs and Nomographs (Lyons & Carnahan) A workbook that develops concepts and skill in the making and reading of graphs
Metric Trundle Wheel (Invicta) Wheel designed to introduce concepts of linear measurement
100 g Balance (ESA) A plastic balance for weighing masses of between 1 gram and 100 grams
Tell-Time Quizmo (Milton Bradley) A lotto-type game to stimulate interests in telling time

GLOSSARY

addition Putting together



array 5 columns

3 rows

$3 \times 5 = 15$

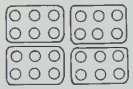
digit Any of the symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

division

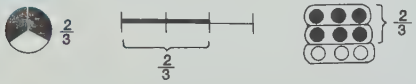
$24 \div 6 = 4$ or $6\overline{)24}$ (4)

24 (4×6)

0



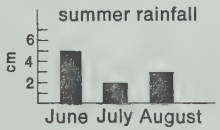
fraction A number that tells how much



$\frac{2}{3}$ ← numerator (how many parts shaded)
$\frac{2}{3}$ ← denominator (how many parts in all)

graph A way of picturing information

a bar graph:



line segment A part of a line

math sentence

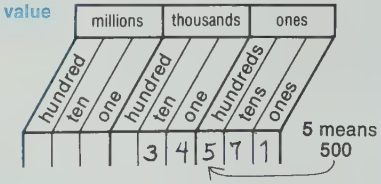
addition: $3 + 4 = 7$
subtraction: $16 - 7 = 9$
missing factor: $3 \times \square = 12$
division: $12 \div 3 = 4$

multiplication

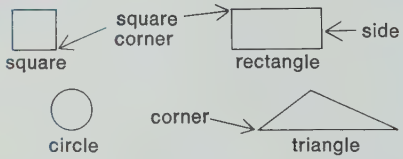
$3 \times 5 = 15$

factor factor product

place value

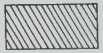


plane figure



region

circular region



rectangular region

renaming

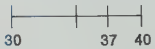
$$\begin{array}{r|l} 2 & 14 \\ \cancel{3} & \cancel{4} \\ -1 & 9 \\ \hline 1 & 5 \end{array}$$

← 3 tens 4 ones renamed as 2 tens 14 ones

$$\begin{array}{r} {}^{1} \\ 56 \\ +29 \\ \hline 85 \end{array}$$

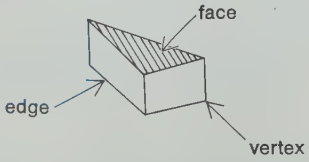
15 ones renamed as 1 ten 5 ones

rounding



37 is closer to 40 than to 30. 37 rounds to 40.

solid object



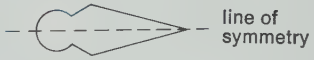
standard unit of measure An agreed-upon length, weight, or capacity used to measure things. (See Tables of Measure.)

subtraction Taking away

symbol

+	plus	>	is greater than
−	minus	<	is less than
×	times	=	equals
÷	divided by	)‾	division problem

symmetry Fold along the line. The two parts match.



tally chart A way to record a count

Games Won

Joe	𝍸 𝍸 𝍸 𝍸
Sam	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸

tally marks

whole number Tells how many
0, 1, 2, 3, 4, 5, and the rest of the counting numbers
even numbers—0, 2, 4, 6, and so on
odd numbers—1, 3, 5, 7, and so on

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1: Photo Researchers (Cooke). **37:** Magnum (Uzzle). **47:** Magnum (Malloch). **48:** Magnum. **83:** *l* Magnum (Arnold). **84:** Magnum (Hartmann). **97:** Monkmeyer (Shackman). **101:** Photo Researchers (Thomas). **106:** DPI (Zalon). **107:** Monkmeyer (Lanks). **109:** Photo Researchers (Angermayer). **119:** Magnum (Hartmann). **143:** Magnum (Capa). **118:** *l* Photo Researchers (Angermayer); *r* Magnum (Henriques). **145:** Black Star (Evenhon). **152:** Monkmeyer (Rogers). **163:** George L. Senty. **174:** Magnum (Lessing). **190:** Photo Researchers (Thomas). **193:** Magnum (Hartmann). **197:** Magnum (Hartmann). **199:** Magnum (Yenne). **201:** Monkmeyer (Forsyth). **217:** Monkmeyer (Fujihira). **220:** Photo Researchers (Cooke). **221:** Black Star (Ward). **233:** *tl* Monkmeyer (Forsyth); *bl* DPI (Corlett); *ml* Black Star (McCoy); *tm* Nancy Palmer Agency (Hinton); *bm* Monkmeyer (Anderson); *br* Monkmeyer (Rogers); *tr* Magnum (Harbutt). **237:** Rapho Guillumette (Johns). **238:** Suzanne Szasz. **256–57:** Monkmeyer (Forsyth). **259:** Black Star (Wilson). **283:** Magnum. **303:** Monkmeyer (Attaway).

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TABLES

LENGTH

1760 yards (yd.) = 1 mile

METRIC

10 millimetres (mm) = 1 centimetre
10 centimetres (cm) = 1 decimetre
10 decimetres (dm) = 1 metre
10 metres (m) = 1 dekametre
10 dekametres (dkm) = 1 hectometre
10 hectometres (hm) = 1 kilometre (km)

AREA

144 square inches (sq. in.) = 1 square foot
9 square feet (sq. ft.) = 1 square yard
4840 square yards (sq. yd.) = 1 acre
640 acres = 1 square mile
1 square mile (sq. mi.) = 1 section (of land)
36 sections = 1 township

100 square millimetres (sq. mm) = 1 square centimetre
10,000 square centimetres (sq. cm) = 1 square met
100 square metr
100 square ar
100 hectares

WEIGHT

16 drams (dr.) = 1 ounce
16 ounces (oz.) = 1 pound
2000 pounds (lb.) = 1 ton (tn.)

10 milligram
10 centigra
10 decigra
10 grams (g
10 dekagra
10 hectogra
1000 kilogra

VOLUME

1728 cubic inches (cu. in.) = 1 cubic foot
27 cubic feet (cu. ft.) = 1 cubic yard (cu. yd.)

1000 cubic
1000 cubic
1000 cubic

CAPACITY

Liquid
2 cups (c.) = 1 pint
2 pints (pt.) = 1 quart
4 quarts (qt.) = 1 gallon (gal.)

Dry
2 pints (pt.) = 1 quart
8 quarts (qt.) = 1 peck
4 pecks (pk.) = 1 bushel (bu.)

Liquid and D
10 millilitres
10 centilitres
10 decilitres
10 litres (l)
10 dekalitres
10 hectolitres

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